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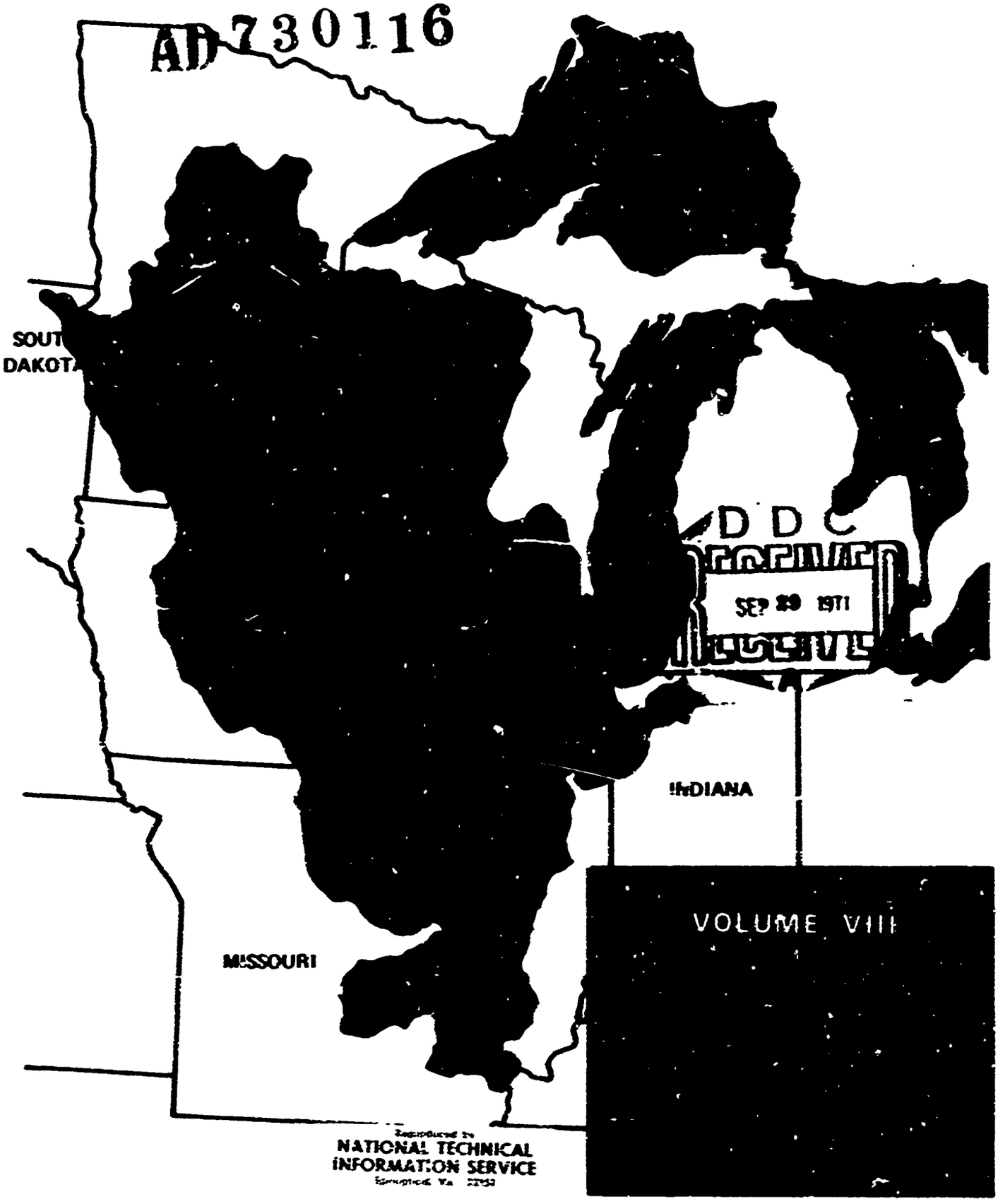

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Appendix P. Economic Base Study and Projections

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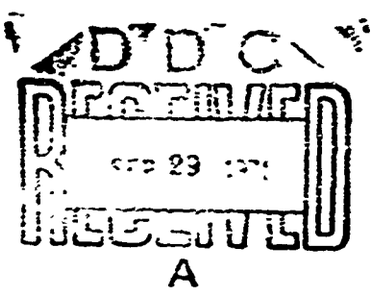
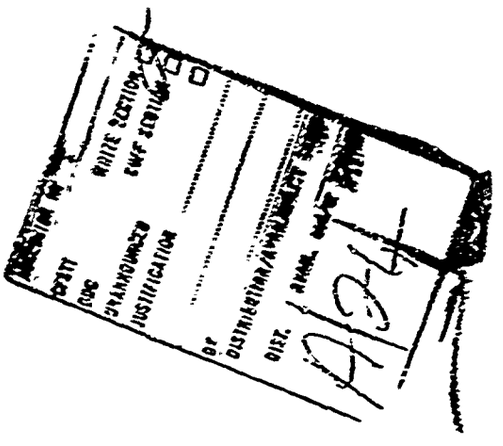


For

UMRCBS Coordinating Committee

This study by the Upper Mississippi River Basin Coordinating Committee was prepared at field level and presents data for a framework program for the development and management of the water and related land resources of the Upper Mississippi River Basin. This report is subject to review by the interested Federal agencies at the departmental level, by the Governors of the affected States, and by the Water Resources Council prior to its transmittal to the Congress for its consideration.

The main report contains the recommendations of the Coordinating Committee. Recommendations that may be included in the appendixes are in effect merely suggestions by the author agencies and are not to be construed as Coordinating Committee recommendations.



UPPER MISSISSIPPI RIVER

COMPREHENSIVE BASIN STUDY

APPENDIX P

ECONOMIC BASE STUDY AND PROJECTIONS

Prepared by

the

Economics Advisory Committee

For

UMRCBS Coordinating Committee

OUTLINE

UPPER MISSISSIPPI RIVER COMPREHENSIVE BASIN STUDY REPORT

SYNOPSIS

This appendix has developed estimates of the growth of water dependent elements in the economy of the Upper Mississippi River Basin to provide measures of requirements for future water and related land resource development. To serve the purpose of the total Upper Mississippi River Comprehensive Basin Study, trends and projections of economic and demographic changes are developed for the Nation, Multistate Region, the Basin, Economic Subregions and Plan Areas.

The 302 counties in the Basin plan areas, as a total, increased in population from 16.7 million in 1950 to 19.3 million in 1960 and are projected to increase to 26 million in 1980 and 48 million by 2020. The areas of major growth in the Basin are projected to be the large metropolitan areas. The projected continuing decline of farm population and the rapid increase in nonfarm population indicates the need to examine closely the developments in the urban areas regarding changes in population density and water use requirements.

Total employment in the plan areas is projected to increase from 7.6 million in 1960 to 9.9 million in 1980 and 17.6 million in 2020. The composition of employment for the total Basin by major sectors is projected to undergo some very dramatic changes in the study period. In 1960 manufacturing was the No. 1 ranking industry with services being No. 2 in rank. By 2020 the situation is projected to be reversed. Retail trade remains the No 3 employer during the study period. Government becomes the fourth ranking employer by 2020 and is just slightly above the level of finance, insurance and real estate sectors of employment. The increase in employment of the noncommodity producing industries is markedly greater than that of the commodity producing industries. This, in turn, has a very significant effect on the total population and hence on any of the water resource requirements based upon population.

Dramatic increases are expected in the growth of personal income in the Basin. These increases will assert themselves in terms of a higher standard of living in the Basin and demand for additional water resources for homes, recreation, water supply, quality control and other factors. Per capita income in the Basin which was $2,410 in 1960 is projected to increase, based on an index of 1960 equals 100, to 170 in 1980 and 427 by 2020. As one would suspect, highest per capita income areas are those plan areas which include major metropolitan areas such as Illinois North (Chicago), Mississippi Headwaters (Minneapolis-St. Paul) and Meramec (St. Louis).

The demand for fuel, food and livestock and livestock products will rise by about 3 times by the year 2020. The demand for wood probably will increase by about 2.5 times. The need for land for agricultural production will rise 1.2 million acres (or 1.7 percent) by 1980 and another 3.5 million acres by 2020. Requirements for land for urban and other uses can be expected to increase about 5 million acres by 2020 from about 6 million acres in 1960.

Total mining employment is projected to increase from 30.8 thousand employees in 1960 to 57.0 thousand in 2020, an index of change of about 185 based on 1960 as 100. Productivity, the measure of output per worker, is projected to make strong advances during the projection period. Mineral production indexes of change for 2020, based on 1960 as 100, range from 177 for coal and 288 for iron ore to a high of 678 for sand and gravel.

Electric power generation in the Basin is expected to undergo considerable changes in the 1960-2020 study period. Estimates for nuclear power supply are set at 33 percent of the total thermal supply for 1980, 70 percent in 2000 and 81 percent in 2020. The hydroelectric supply from known sites is estimated at less than 2 percent of total sources of electric power generation in 2020.

In conclusion, measured by population, labor force, employment and personal income, the Upper Mississippi River Basin is expected to continue to grow at a more rapid pace than its multistate area, but slightly less than the national pace.

FOREWORD

Appendix P was developed through a coordinated effort by participating organizations as follows: Economic Research Service, Forest Service, and Soil Conservation Service of the Department of Agriculture; Bureau of Mines, Federal Water Pollution Control Administration, Bureau of Outdoor Recreation, and Bureau of Sport Fisheries and Wildlife of the Department of the Interior; the Federal Power Commission; and the states of Illinois, Indiana, Iowa, Minnesota, Missouri and Wisconsin. The U.S. Army Corps of Engineers, NCD, had the responsibility for coordinating Appendix P. This study was initiated prior to the Federal program of economic projections by the Office of Business Economics of the Department of Commerce, and the Corps contracted for the services of a private economic consultant, the National Planning Association, to undertake the part of the study concerned with the general economic and demographic analysis and projections. Federal agencies provided the basic data and projections for the agricultural, forestry, mining and electric power sectors of the economy. Employment data were furnished to the National Planning Association by the state employment security commissions under an arrangement with the U.S. Department of Labor.

Technical reports, draft copies of reports, and preliminary projections were reviewed by the Economics Advisory Committee of the UMRCBS during the period of preparation of this appendix. The Coordinating Committee of the UMRCBS has been furnished information copies of the reports and proceedings of the Economics Advisory Committee. Also, other persons participating in this study and persons having a specialized interest in this study have been recipients of the technical and preliminary reports for the Economics Base Study.

Members of the Economics Advisory Committee who were the major authors of the various sections of Appendix P are as follows: Section 1 - Robert A. MacLauchlin, A. William Hanson and Howard E. Olson of the Corps of Engineers; Section 2 - Sidney Sonenblum, Louis H. Stern, and B. D. Hong of the National Planning Association; Section 3 - Ray Lanier, M. L. Cotner, Roger Strohbehn and Ronald Rhoade of the Economic Research Service; Section 4 - Clarence Chase, Sanford Silver, and Tom Jordan of the Forest Service; Section 5 - Donald F. Klyce of the Bureau of Mines; Section 6 - Lenard B. Young, Orel Haukedahl, and Elmer Iiker of the Federal Power Commission; and Section 7 - Wesley Grosh and Donald F. Klyce of the Bureau of Mines; Carlyle Pemberton and Merle Tellekson of the Federal Water Pollution Control Administration; Robert A. MacLauchlin and Robert M. McIntyre of the Corps of Engineers; W. C. Hollenbaugh, Bureau of Outdoor Recreation; Lenard B. Young and Orel Haukedahl of the Federal Power Commission; Sanford Silver of the Forest Service; and William Meyer of the Bureau of Sport Fisheries. Letters from states were provided by Gene Graves, Illinois; Clifford L. Summers, Missouri; and Donald F. Wood, Wisconsin.

Other persons who made contributions to technical reports and/or review of the drafts of the appendix are: J. Dunbar, Indiana; M. H. Meyer, Soil Conservation Service; W. Nord, Bureau of Sport Fisheries and Wildlife, W. J. Schuck, Federal Water Pollution Control Administration, Donald F. Wood, Wisconsin; and Michael Furman, Indiana.

The staff of the Economics Branch, NCD, Corps of Engineers that worked in preparing the many phases of this report are Lena Adler on statistical work and report makeup and Jeanette Petersen on typing. Robert A. MacLauchlin was the chief editor for Draft No. 3. General supervision was by Howard E. Olson, Chairman of the Economics Advisory Committee. The study was under the general direction of James S. King, Corps of Engineers, until his untimely death in 1968. Coordination with the Upper Mississippi River Comprehensive Basin Study was through Edwin V. Weiss of the Corps of Engineers. Edwin W. Nelson provided guidance in early phases of this report and C. F. MacNish was the authorized representative for the Contracting Officer for the contract with the National Planning Association. N. A. Back, Office Chief of Engineers, furnished counsel in the development of the specifications and the study.

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Section 1

THE BASIN ECONOMY IN A NATIONAL MULTISTATE AND REGIONAL SETTING WITH ECONOMIC PROFILES BY PLAN AREAS

1.1 Authorization

The U.S. Army Engineer Division, North Central, was assigned the responsibility for the coordination of the Upper Mississippi River Comprehensive Basin Study (UMRCBS). This study was made with the cooperative effort of Federal, state, and local agencies. As part of their responsibility for the coordinating of the Upper Mississippi River Comprehensive Basin Study, the Corps of Engineers had the responsibility of coordinating the economic base study. The cooperating Federal agencies and state governments are discussed in subsection 1.4.

1.2 Purpose

The Economic Base Study and Projections develop the information necessary regarding the future economic and demographic changes of the Upper Mississippi River Basin to serve as guides for the development of water resource requirements or demands. These demands are projected based on the information supplied in this appendix and, together with related materials, will be used as the basis for determining the water and related land resource needs and the required development. Section 7 of this appendix contains summary statements of methodologies proposed for use by Federal agencies and states in developing the demands that have been placed upon water resources as based on the projections included in this appendix. On the basis of the data and projections developed in this appendix, quantitative, qualitative and time-phased requirements for present and future control, use and conservation of water in related land resources of the Basin will be determined by the Federal agencies and states cooperating in this study. The plan to be developed will be for flood control, navigation, hydroelectric power, municipal and industrial water supply, water quality control, recreation, fish and wildlife conservation, agriculture, forestry and other water related land uses.

1.3 Area Included

The Economic Base Study and Projections covers the Upper Mississippi River Drainage Basin and economically related areas. The Upper Mississippi River Basin is defined for the purpose of this study as the Mississippi River Basin above the mouth of the Ohio, excluding the Missouri River Basin. The area involved is approximately 188,000 square miles which includes major portions of the states of Minnesota, Wisconsin, Iowa, and Illinois, a substantial part of Missouri and small areas of Indiana and South Dakota. The study area had a population of about 19 million persons in 1960. Since future economic development of the Upper Mississippi River Basin will not occur in geographic isolation, this study includes consideration of areas beyond the Basin boundaries which will influence economic development in the area of principal interest.

1.4 Organization of Study

This appendix is organized as described in the preface and as shown in the table of contents. The expertise of Federal agencies and states was used to the extent feasible to develop the various inputs for this study. The general economic and demographic projections undertaken by the National Planning Association (NPA) under contract with the Corps of Engineers were based to a considerable extent on historical trends of the nation in a multistate region, the Basin, and its plan areas. The physical resource base was used in the projections made by the contributing agencies such as the Economic Research Service and Forest Service of the Department of Agriculture and the Bureau of Mines of the Department of the Interior. Preliminary projections were developed by each of the major contributors during the progress of this effort. These preliminary projections were in turn used by the NPA and cooperating agencies in the study to develop refined projections with feedback that is implicit in the interaction of the various sectors of the economy. The use of the physical resources in developing projections of agriculture, forestry, and mineral output and hence employment is believed to be a necessity in view of the expanding technology and the abrupt changes possible in terms of depletion or discovery of new resources.

1.5 Scope of Work

The work undertaken in this appendix includes analysis at the national, regional, Basin, and plan area levels. The paragraphs that follow briefly summarize the scope of work.

1.5.1 General

Economic and demographic data pertaining to the economic base of the Basin are developed for current and past periods and trends are shown. Interrelationships are analyzed for those that exist between the Basin and the national-regional economies. In general, the base year used was 1960 with exceptions for appropriate data reporting years. Projections are developed for the years 1980, 2000, and 2020.

1.5.2 National and Regional Economies

The economic activities of the Basin are tied to the activities of the rest of the nation. This results from trading relationships between the Basin and the rest of the Nation and because the Basin competes with other areas for growth in national activity. In establishing the national-Basin relationship this study also includes analyses of national-regional economic growth, technological changes and economic and other factors which would influence the future of the Basin.

1.5.3 Basin Economy

For certain economic sectors an overall Basin allocation was made at the national level by national study groups, especially for crops and livestock for agriculture and forest production. The general demographic projections are related to the Nation in terms of fertility rates and migration.

1.5.4 Basin Plan Areas and Economic Subregions

This appendix has developed estimates of the growth of the water associated elements in the Basin's economy to provide measures of the problem of requirements for future water resource development. To serve the purpose of the total Upper Mississippi River Comprehensive Basin Study, trends and projections of economic and demographic changes are developed for plan areas of the Basin. Delineation of the plan areas was determined by mutual agreement of members of the Economics Advisory Committee in association with representatives of other advisory committees. These plan areas were defined based on drainage subbasins of the Mississippi River Basin, generalized to county lines. However, development of projections for the Basin plan areas required the use of a procedure of first developing the general economic and demographic projections for economic regions based upon the areal organization of economic activity. The delineation of the economic subregions was such as to minimize the impact of employees commuting between the economic subregions. In summary, the two types of areas used in this study are: (1) Basin plan areas based on hydrologic criteria, shown in *Figures P-1* and *P-3* and (2) the economic subregions shown in *Figures P-2* and *P-23*. Available data made a statistical necessity of defining areas based on county boundaries. The Basin plan areas include 302 counties and the economic subregions 321 counties. Economic profiles and data for Basin plan areas are given by county in *Tables P-13* through *P-46*. A listing of counties in economic subregions is found in *Table P-49*.

1.5.5 Major Economic Parameters

Projections have been developed in this appendix for four major economic factors: (1) population, (2) employment, (3) production, and (4) personal income. Population projections by farm and nonfarm categories have been developed for the economic subregions and the Basin plan areas. Additional demographic information such as age, sex, and other characteristics were projected for the economic subregions as part of the necessary analysis. Employment has been developed and projected for major industry groups. Population was derived based upon employment. Indexes of production, using value added by manufacture, have been developed for selecting manufacturing industries. Production was projected for agriculture, forestry, minerals, and electric power.

1.6 Relation of Economic Projections for Type I and Subsequent Studies

The projections that have been developed in this appendix are predicated on a series of assumptions which are explicitly stated in each part of this study. Subsequent studies, such as Type II studies, may undertake a greater detail in analysis than the Type I framework and may develop projections that may vary from those projections contained in this appendix. A departure in subsequent studies from projections in this appendix may be warranted based on later data, more detailed data, and perhaps even using assumptions differing from those used in this Type I general framework study. This Type I appendix offers a baseline projection which can become a point of departure for subsequent studies. This approach will provide a consistent baseline from which to evaluate future economic projections. Among the forces that might change the assumptions made in this study are programs undertaken or not undertaken by Federal, state, and local governments. Fertility rates are subject to change. Regional economic development within the Nation and resultant competitive relationships will be more completely analyzed after all Type I studies for the Nation are completed. Also unforeseen technology may develop which could have a major impact on the projections.

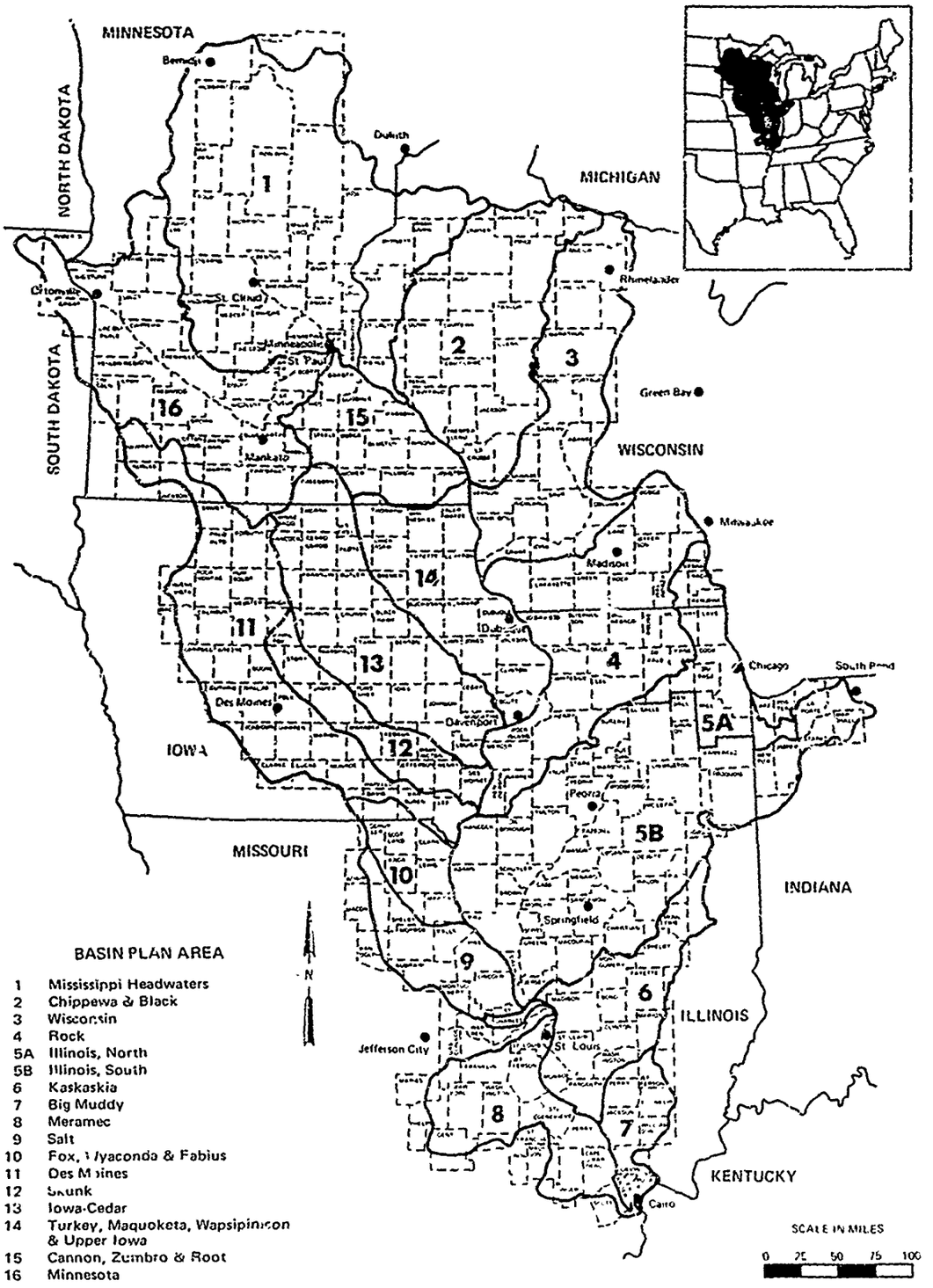

Figure P-1. Upper Mississippi River Basin plan areas.

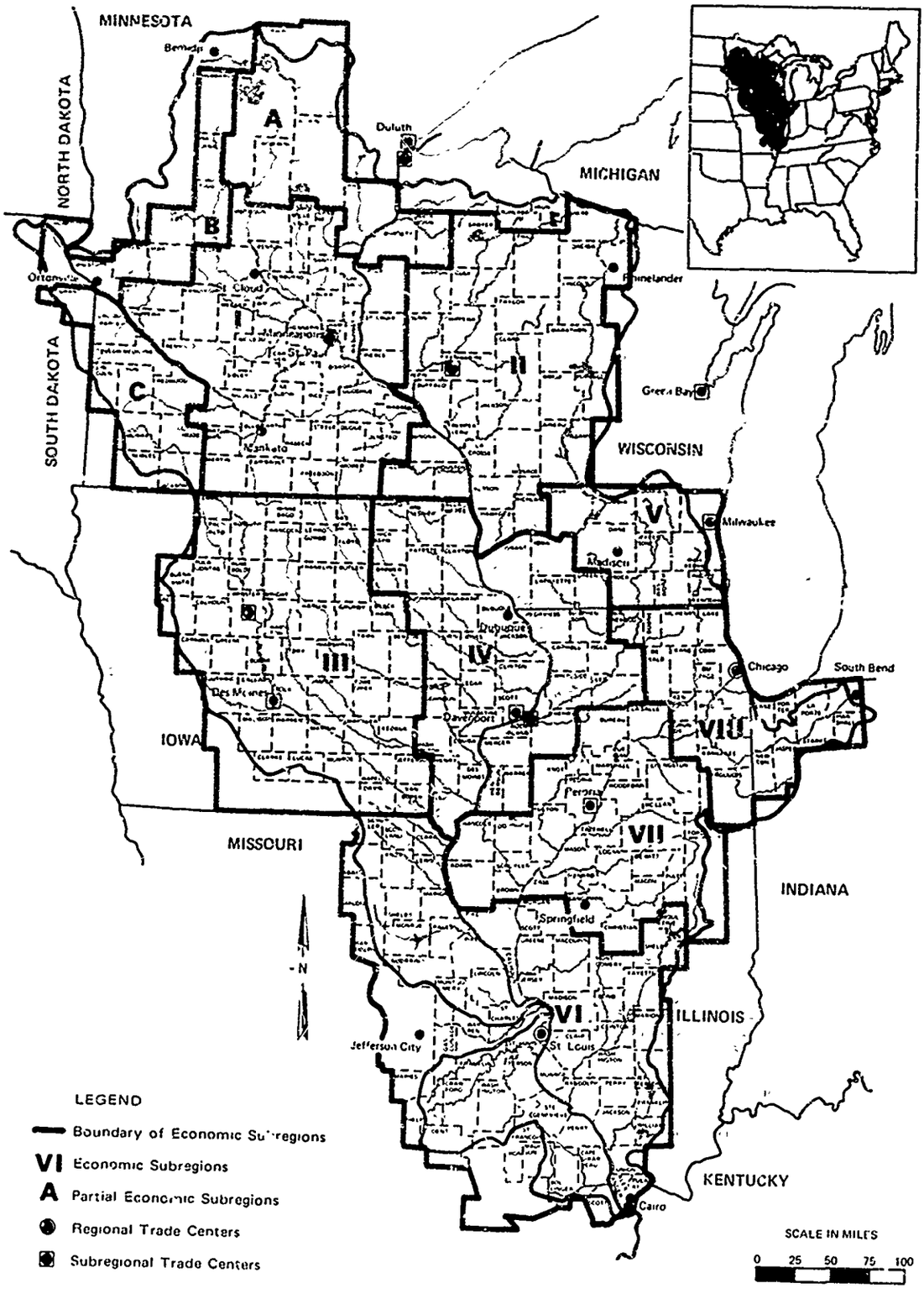

Figure P-2. Upper Mississippi River Basin economic subregions.

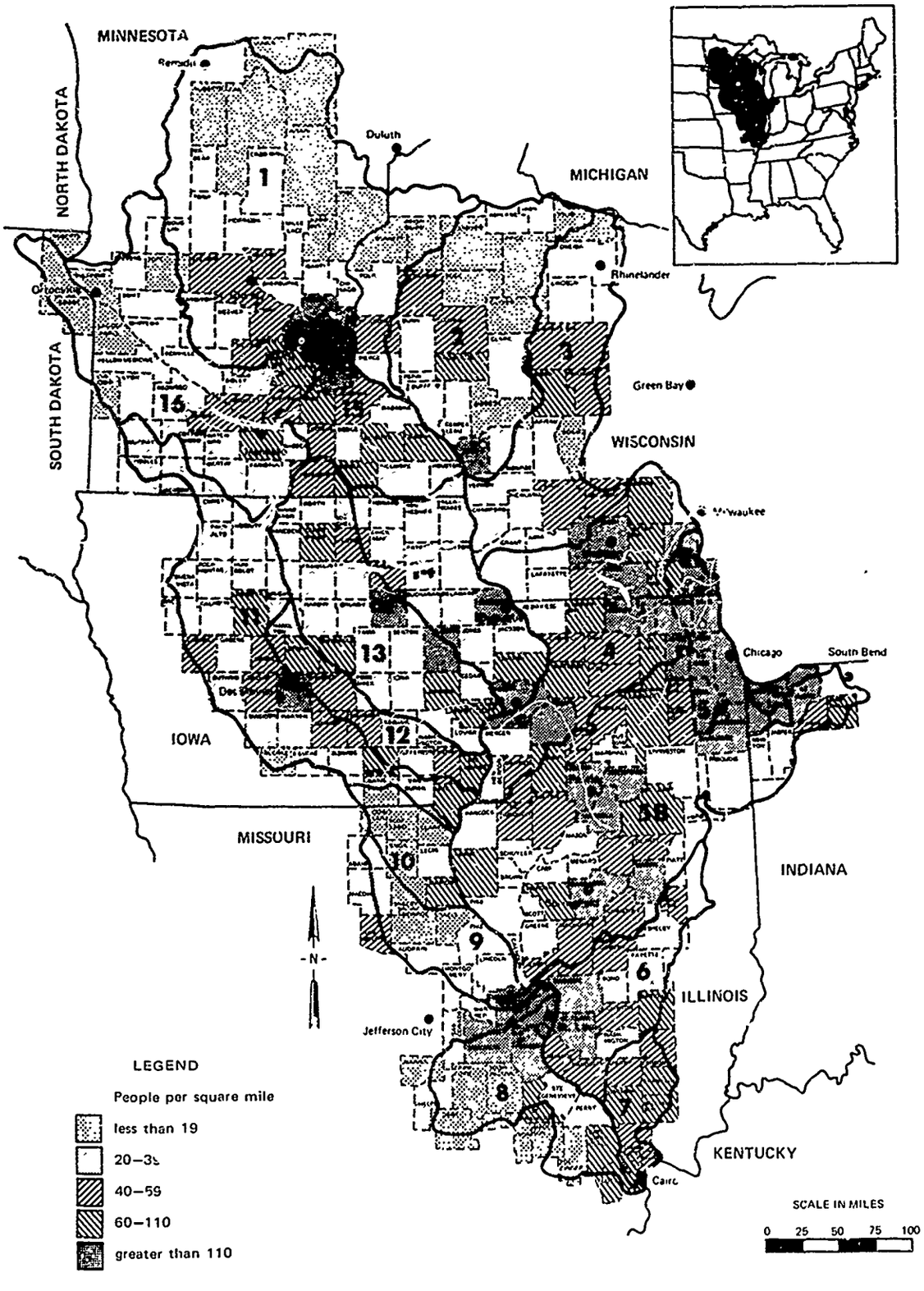

Figure P-3. 1960 population density by county, Upper Mississippi River Basin plan areas.

Revisions in economic and demographic projections may be developed as part of the new Federal program of economic projections for the Nation and major river basins. If such revisions are deemed to have a significant impact on plan formulation, the revisions can be accommodated in subsequent studies based upon the relationships developed in this appendix for the Basin and its component geographic subdivisions.*

1.7 Summary – General Economic Outlook for the Nation, Multistate Region and Basin

The population, employment, and personal income for the Nation, multistate region and Basin are summarized for these major areas in the text of this section and in *Table P-1* and *Figure P-4* on pages immediately following this discussion. The data and projections in this section are based on the NPA analysis and projections in Part II, Draft No. 2 of Appendix P, dated June 1968.

1.7.1 Nation

Events of the past few decades are evidence of the economy of the U.S. being able to absorb a new and ever-increasing population and at the same time creating a higher standard of living. In the last three and one-half decades the Nation's production of goods and services (in real terms) has tripled. With the population increasing by about 60 percent and employment by about 50 percent, this has left room for a 75 percent increase in per capita consumption, a 400 percent increase in government services, a 140 percent increase in business investment, and a reduction of 8 hours in the average work week.

United States population, which was about 180 million in 1960 and 200 million in 1967, is projected to reach about 240 million by 1980 and 460 million by the year 2020, as shown in *Table P-1* and *Figure P-4*. This represents an annual growth of about 1.5 percent in the past 3 decades. Most of the projected growth is attributed to natural increase with a small proportion of foreign immigration. Employment is expected to about double to 130 million by the year 2000, from 67 million in 1960, representing an annual growth rate of 1.6 percent. The Nation by the year 2020 is likely to have as many employed persons as it had people in 1960. Total personal income is expected to reach almost $1,000 billion by 1980 and $2.2 trillion by 2000, up from $400 billion in 1960 and $500 billion in 1965. While the annual increase in the last 30 years has been about 3 percent and 4 percent in 1960-65, it is projected at over 4 percent in the next 30 years. Per capita personal income in 1960 was $2,200 and is projected to be $4,100 in 1980, $6,700 in 2000, and $10,500 in 2020. This rate of increase is much faster than the pace experienced in the past 30 years.

1.7.2 Multistate Region

The six states of the multistate region, Illinois, Indiana, Iowa, Minnesota, Missouri, and Wisconsin, as a whole, are expected to continue to grow at a slightly slower pace than the Nation. Thus, while the area had 16 percent of the Nation's population in 1960, it is expected to have 15 percent by 1980 and 14 percent by 2020. Similar trends are shown in labor force, employment, total personal income and per capita personal income. In absolute growth terms, there are very substantial increases in the multistate region. By 1980 the region is projected to have 38 million people, of whom 15 million will be in the work force with 157 billion dollars in personal income with an average per capita income of $4,200. These compare with 29 million people, 12 million employees, 68 billion dollars in personal income, and $2,300 in per capita income in 1960.

The multistate region has had an unfavorable industry mix and has been at a comparative disadvantage in the location of most industrial sectors. Both of these factors contributed to the relatively sluggish employment growth in the region during the post-war years. The region is expected to lag behind the rest of the Nation in its pace of total employment growth over the next 3 decades, reflecting an unfavorable industrial composition and below-average growth on an industry-by-industry basis.

1.7.3 Upper Mississippi River Basin

Since the Basin area accounts for a preponderant share of the multistate regional activities, future developments in the Basin are expected to roughly parallel developments in the multistate region. Population, labor force,

*The preliminary national projections (March 1968) of population, employment, and personal income by the Office of Business Economics (OBE), USDC, use U.S. Bureau of Census Series C national population projections. Series C projections use a slightly lower fertility rate than an adaptation of the Census Series B population projections that were used in this appendix. This difference at the national level is about 3 percent in 1980, 8 percent in 2000, and 15 percent in 2020. However, the preliminary per capita personal income projections and the resultant total personal income for the Nation are slightly higher in the OBE preliminary projections than those developed in this appendix. The OBE preliminary projections are currently under review prior to final projections being completed. Any differences in the Basin projections are not known at this time. Any impact of differences of the projections on the planning elements of the Upper Mississippi River Comprehensive Basin Study is viewed as not being significant for this Type I study.

Table P-1

Summary of Population, Employment and Income for the United States, Multistate Region, and Upper Mississippi River Basin Plan Areas — Actual 1960 and Projected 1980, 2000 and 2020

Area	Actual	Projected		
	1960	1980	2000	2020
Population (thousands):				
Nation	179,986	241,288	331,013	460,576
Multistate	29,209	37,665	48,880	66,223
Basin Plan Areas	19,316	26,153	35,309	48,230
Population Index (1960 = 100):				
Nation	100	134	184	256
Multistate	100	129	167	227
Basin Plan Areas	100	135	183	250
Employment (thousands):				
Nation	66,579	94,680	129,209	174,100
Multistate	11,544	15,069	19,574	25,470
Basin Plan Areas	7,553	9,920	13,194	17,581
Employment Index (1960 = 100):				
Nation	100	142	194	261
Multistate	100	131	170	221
Basin Plan Areas	100	131	175	233
Total Personal Income (Millions of 1960 dollars):				
Nation	399,028	989,500	2,218,400	4,854,100
Multistate	67,535	156,950	330,184	704,282
Basin Plan Areas	46,564	107,366	232,555	495,844
Total Personal Income Index (1960 = 100):				
Nation	100	248	556	1216
Multistate	100	232	489	1043
Basin Plan Areas	100	231	499	1065
Personal Income Per Capita (1960 dollars):				
Nation	2,217	4,100	6,700	10,500
Multistate	2,312	4,200	6,800	10,600
Basin Plan Areas	2,410	4,100	6,600	10,300
Personal Income Per Capita Index (1960 = 100):				
Nation	100	185	302	475
Multistate	100	180	293	460
Basin Plan Areas	100	170	273	427

employment, and total personal income are expected to continue to grow at a more rapid pace than the multistate and approach the national pace. Basin population is projected to increase from 19 million in 1960 to 26 million by 1980 and 48 million by 2020.

Employment in the Basin is expected to reach 10 million by 1980 and 18 million by 2020, implying increases of 31 percent and 133 percent, respectively, over the 1960 level of 7.6 million. About half of the employment increase will originate in services and education with another two-fifths accounted for by the growth of trade, government, finance-insurance-real estate, and contract construction. Total personal income is expected to increase 130 percent between 1960 and 1980 (in constant prices) which reflects an appreciable increase in per capita income from $2,400 in 1960 to $4,100 in 1980, $6,600 at the turn of the century, and $10,300 by 2020. Per capita income in the Basin is currently slightly above the national average, although it is projected to fall slightly below the national level after 1980.

1.8 Summary of Projections for Economic Subregions

Total population for the sum of the economic subregions of the Basin is expected to increase from 21 million in 1960 to 53 million in 2020 or about 2.5 times, as shown in *Table P-2*. The economic subregions ranged in size of population in 1960 from 7.7 million for Chicago, 3.3 million for St. Louis, 2.4 million for Minneapolis St. Paul, and 2.1 million for Milwaukee, down to 0.8 million for Eau Claire, Wisconsin. Three partial economic subregions, A, B,

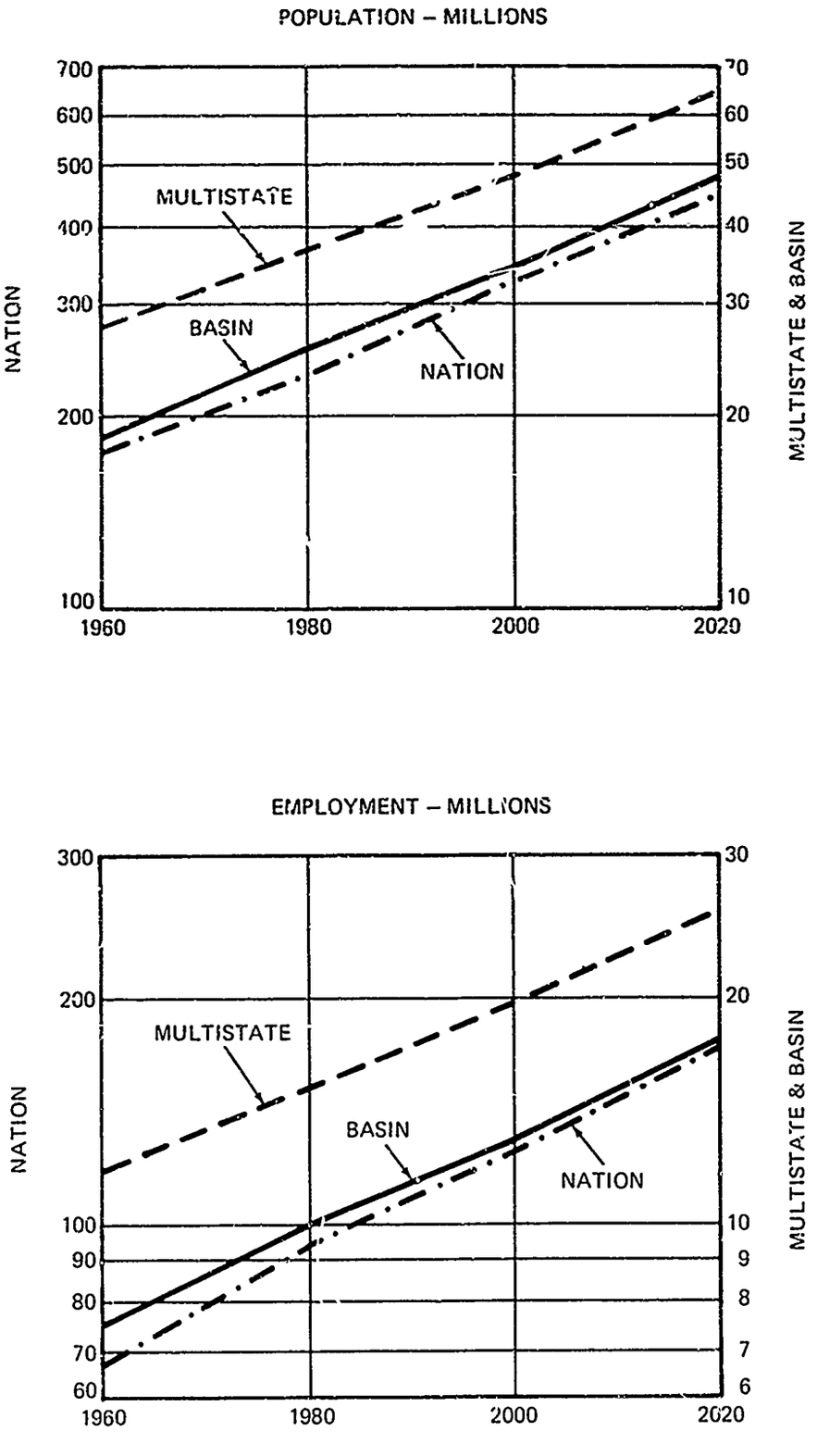

Figure P-4. Population, employment and total personal income for the nation, multistate and basin plan areas.

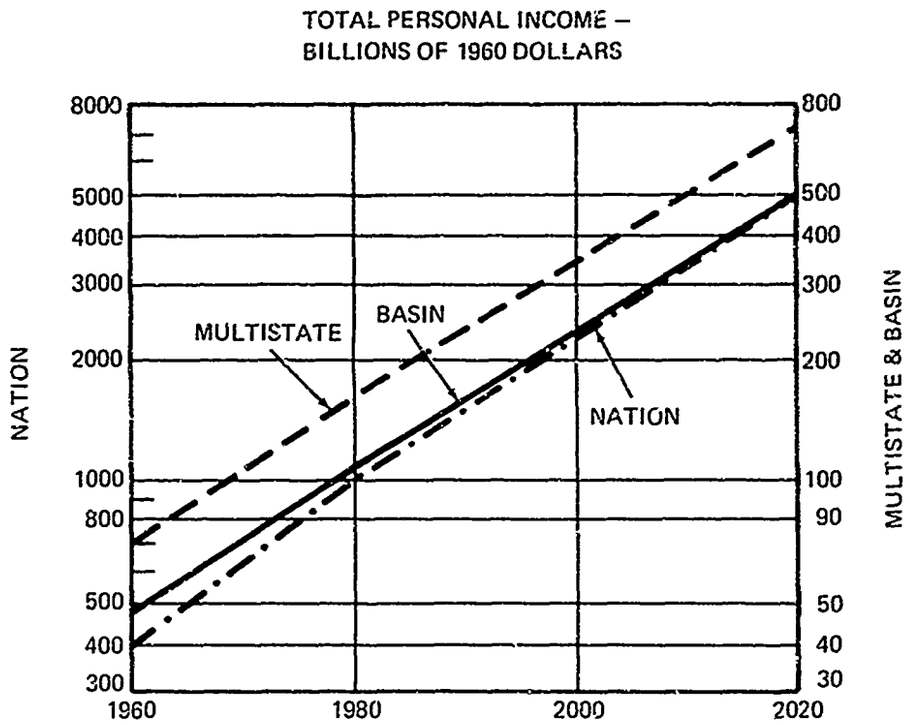

Figure P-4. Population, employment and total personal income for the nation, multistate and basin plan areas. (con.)

Table P-2

Population and Indexes, Upper Mississippi River Basin Economic Subregions – 1950–2020*

No	UMRB Economic Subregions Description	Year 1950	1960	1970	1980	1990	2000	2010	2020
Total Population (thousands of inhabitants)									
A	NE Minnesota	138	136	120	128	149	174	201	234
B	NW Minnesota	119	112	96	99	102	104	108	113
C	SW Minnesota	165	163	148	153	167	174	192	208
I	Minneapolis St. Paul	2,027	2,439	2,973	3,646	4,230	4,901	5,584	6,588
II	Eau Claire	803	820	936	1,052	1,248	1,392	1,601	1,819
III	Des Moines-Ft. Dodge	1,335	1,389	1,594	1,840	2,151	2,448	2,852	3,272
IV	Davenport-Rock Island-Moline	1,302	1,432	1,573	1,844	2,193	2,552	3,052	3,569
V	Milwaukee	1,676	2,096	2,580	3,162	3,789	4,384	5,218	6,069
VIII	Chicago	6,283	7,656	8,774	10,467	12,370	14,290	16,723	19,601
VII	Peoria	1,334	1,470	1,616	1,937	2,251	2,621	3,079	3,645
VI	St. Louis	3,002	3,329	3,829	4,254	5,065	5,845	6,734	7,785
	Total Basin	18,189	21,042	24,242	28,682	33,715	38,785	45,354	53,003
Indexes (Based on 1960 = 100)									
A	NE Minnesota	101	100	88	94	110	128	148	172
B	NW Minnesota	106	100	86	88	91	93	97	101
C	SW Minnesota	101	100	91	94	102	107	118	128
I	Minneapolis-St. Paul	83	100	122	149	173	197	229	270
II	Eau Claire	98	100	114	128	152	170	195	222
III	Des Moines-Ft. Dodge	96	100	115	132	155	176	205	236
IV	Davenport-Rock Island-Moline	91	100	110	129	153	178	214	256
V	Milwaukee	80	100	123	151	181	209	249	290
VIII	Chicago	82	100	115	137	162	187	218	256
VII	Peoria	91	100	110	132	153	178	209	248
VI	St. Louis	90	100	115	131	152	176	202	234
	Total Basin	86	100	115	136	160	184	216	252

*See Figure P-23 and Table P-49 for the counties included in the economic subregions.

and C, respectively, northeast Minnesota, northwest Minnesota, and southwest Minnesota, are outlying areas with the regional center of the economic subregion outside of the Basin. In terms of growth changes, the most rapidly growing economic subregion, historically and projected, is Milwaukee, as shown in *Table P-2*. The second most rapidly growing economic subregion is Minneapolis-St. Paul, and the third is the Chicago and Davenport-Rock Island-Moline subregion; fourth is Peoria, fifth is Des Moines-Fort Dodge, and sixth is St. Louis. The partial economic subregions of northeast, northwest and southwest Minnesota, which are predominantly agricultural areas without major regional center, show population losses in the next few decades by some growth in the latter decades of the projection period. Detailed economic profiles for UMRB Economic Subregions are contained in Section 2 of this report.

1.9 Summary of Projections for Basin Plan Areas

The physiographic unit which forms the basis for plan formulation in water resources studies is the hydrologic basin plan area. In contrast to the 11 previously discussed economic subregions, the Basin is composed of 17 plan areas. Since considerable overlap exists between subregions and plan areas, a disaggregation procedure was required to obtain projections of economic and demographic activity for the 17 plan areas. The disaggregation was accomplished by using a procedure which assigned to each county a share of its economic subregion's projected activity; this share was based on the 1960 county distribution of activity in the subregion. The results obtained for each county were then summed to obtain the desired plan area projections. In a preliminary assessment of the utility of the total projection phase of the UMRCBS Economic Base Study, the conclusion has been reached that projections by economic subregions and plan areas are not mutually exclusive. That is, they may be used interchangeably to analyze the related physical and socio-economic conditions which are inherent in problems of resource development. For planning purposes such as recreation, the economic subregion is often a more meaningful unit; other activities such as water supply and quality control are better assessed on the hydrologic criterion which is the basis of the plan area.

The following paragraphs and tabular presentations contain capsule economic profiles for each of the 17 plan areas in the Basin. Additional detail, particularly on employment and output by SIC categories, is available in Draft No. 2 of Appendix P.

1.9 1 Population

The 302 counties in the Basin plan areas, as a total, increased in population from 16.7 million in 1950 to 19.3 million in 1960 and are projected to increase to 26 million in 1980 and 48 million by 2020, as shown in *Table P-3*. In *Figure P-3* there is a great variety in the population density of these plan areas, from Plan Area 5A, Illinois North, which includes Chicago, with a population of 7.3 million in 1960, to the smallest area, Plan Area 10, Fox, Wyaconda and Fabius river basins in northeastern Missouri, with a total population of 67,000 in 1960. The total population for the Basin plan areas is projected to increase by 2.5 times from 1960 to 2020, as shown in *Table P-3*. Areas that are growing at a greater rate than the Basin average are: (a) Mississippi Headwaters, including Minneapolis-St. Paul Area, (b) the Rock River Basin in Wisconsin and Illinois, which includes Madison, Wisconsin and Rockford, Illinois, (c) the

Table P-3

Population and Indexes, Upper Mississippi River Basin Plan Areas — 1960–2020

UMRB Plan Areas		*Year*			
No.	*Description*	*1960*	*1980*	*2000*	*2020*
Total Population (thousands of inhabitants):					
1	Mississippi Headwaters	2,074	3,098	4,126	5,671
2	Chippewa & Black	312	383	495	635
3	Wisconsin	500	660	894	1,184
4	Rock	1,311	1,752	2,455	3,583
5A	Illinois, North	7,294	10,086	13,741	18,724
5B	Illinois, South	1,764	2,260	3,067	4,290
6	Kaskaskia	714	893	1,123	1,460
7	Big Muddy	223	268	327	425
8	Meramec	1,864	2,568	3,584	4,841
9	Salt	164	178	227	294
10	Fox, Wyaconda, & Fabius	67	75	95	124
11	Des Moines	845	1,112	1,472	1,946
12	Skunk	222	286	392	545
13	Iowa & Cedar	772	1,048	1,407	1,958
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	473	618	856	1,190
15	Cannon, Zumbro, & Root	274	357	455	600
16	Minnesota	443	502	593	760
	Total Basin	19,316	26,153	35,309	48,230
Indexes (based on 1960 = 100):					
1	Mississippi Headwaters	100	149	199	273
2	Chippewa & Black	100	123	159	204
3	Wisconsin	100	134	179	237
4	Rock	100	134	187	273
5A	Illinois, North	100	138	188	257
5B	Illinois, South	100	128	174	243
6	Kaskaskia	100	125	157	204
7	Big Muddy	100	120	146	190
8	Meramec	100	138	192	260
9	Salt	100	109	139	180
10	Fox, Wyaconda, & Fabius	100	111	141	185
11	Des Moines	100	132	174	230
12	Skunk	100	129	177	246
13	Iowa & Cedar	100	136	182	254
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	100	131	181	251
15	Cannon, Zumbro, & Root	100	130	166	219
16	Minnesota	100	113	134	172
	Total Basin	100	135	183	250

Meramec, (d) the Illinois North Basin, which includes Chicago, (e) the Iowa-Cedar Basin in Iowa, and (f) the Turkey Upper Iowa River Area, which includes northeastern Iowa, Plan Area 14. The slowest growing areas are those without major metropolitan areas.

The ranking of plan areas based on size of population and rates of population growth for 1960 to 2020 are shown in *Table P-4*.

As an aid in developing water supply and water quality information, population projections were developed for farm and nonfarm population for plan areas in *Table P-5*. These projections were based upon employment by farm and nonfarm categories and dependency ratios related to those employment categories. The nonfarm population is shown to be the highest for the Illinois North Plan Area, including Chicago, the Mississippi Headwaters Area including Minneapolis-St. Paul, the Meramec Area, including St. Louis, and other areas as shown in *Table P-5*. The rates of growth for the nonfarm population shown in *Table P-5* were derived from the data on farm employment developed by the Economic Research Service. The farm population in 1960 was approximately 2 million, and this is projected to decline to 925,000 by 2020. The rates of decline are highly varied with the urban plan areas such as the Illinois North declining at the greatest rate. Plan areas showing the least decline are the Big Muddy Plan Area 7 and the Fox-Fabius Plan Area 10.

1.9.2 Employment

Total employment in the Upper Mississippi plan areas is projected to increase from 7.6 million in 1960 to 9.9 million in 1980 and 17.6 million in 2020. As shown in *Table P-6*, the rates of growth of employment are slightly less than that of population. Based on an index of 100 in 1960, the total population for the Basin is projected to be 250 in 2020, whereas employment is projected to be 233 in 2020.

The composition of employment for the total Basin by major sectors is projected to undergo some very dramatic changes in the projection period. As shown in *Table P-7* and *Figure P-5*, manufacturing was the No. 1 ranking industry in 1960 with services being No. 2 in rank. By 2020 the situation is projected to be reversed, with services No. 1 and manufacturing No. 2. Retail trade remains as the No. 3 employer during the projection period. Government becomes the fourth ranking employer by 2020 and is about the same level as the finance, insurance, and real estate (F.I.R.E.) sector of employment in 1960.

The composition of the various industry groups in manufacturing employment is shown in *Table P-8*. In 1960 the No. 1 ranking employer in the Basin was nonelectrical machinery, the food industry was No. 2, electrical machinery No. 3, fabricated metals No. 4, and primary metals No. 5. However, by the year 2000 electrical

Table P-4

Ranking of Population and Population Growth by Basin Plan Areas — 1960 and 2020

Total Population				*Population Growth*			
Rank	*Area No.*	*Basin Plan Area*	*1960 Actual Population, thousand*	*Rank*	*Area No.*	*Basin Plan Area*	*2020 Index (1960 = 100)*
1	5A	Illinois, North	7,293.6	1	1	Mississippi Headwaters	273
2	1	Mississippi Headwaters	2,073.6	2	4	Rock	273
3	8	Meramec	1,864.4	3	8	Meramec	260
4	5B	Illinois, South	1,764.4	4	5A	Illinois, North	257
5	4	Rock	1,310.7	5	13	Iowa & Cedar	253
6	11	Des Moines	845.1	6	14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	251
7	13	Iowa & Cedar	772.4				
8	6	Kaskaskia	713.9	7	12	Skunk	246
9	3	Wisconsin	500.1	8	5B	Illinois, South	243
10	14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	473.5	9	3	Wisconsin	237
				10	11	Des Moines	230
11	16	Minnesota	442.6	11	15	Cannon, Zumbro, & Root	219
12	2	Chippewa & Black	311.9	12	2	Chippewa & Black	204
13	15	Cannon, Zumbro, & Root	274.2	13	6	Kaskaskia	204
14	7	Big Muddy	223.2	14	7	Big Muddy	190
15	12	Skunk	221.7	15	10	Fox, Wyaconda, & Fabius	185
16	9	Salt	163.3	16	9	Salt	180
17	10	Fox, Wyaconda, & Fabius	67.3	17	16	Minnesota	172
		Basin Total	19,316.4			Basin Total	250

Table P-5

Upper Mississippi River Basin

Nonfarm and Farm Population by Plan Area – 1960, and Indexes of Nonfarm and Farm Population – 1980–2020

		Nonfarm Population				Farm Population			
		Population, thousand	Index Based on 1960 Equals 100			Population, thousand	Index Based on 1960 Equals 100		
	Plan Area	1960	1980	2000	2020	1960	1980	2000	2020
1	Mississippi Headwaters	1,854.4	159	217	301	219.2	66	48	42
2	Chippewa & Black	206.0	149	214	225	105.9	71	52	46
3	Wisconsin	383.3	154	217	294	116.8	67	55	50
4	Rock	1,114.0	143	210	314	196.7	81	57	44
5A	Illinois, North	7,212.8	139	190	259	80.8	53	29	18
5B	Illinois, South	1,509.2	138	194	277	255.2	72	56	44
6	Kaskaskia	642.3	131	169	222	71.6	69	52	47
7	Big Muddy	194.6	125	158	209	28.7	86	65	61
8	Meramec	1,797.0	141	198	268	66.8	58	39	38
9	Salt	114.0	123	170	235	49.8	76	68	54
10	Fox, Wyaconda, & Fabius	46.4	124	170	240	20.9	84	77	62
11	Des Moines	652.8	149	209	283	192.3	74	57	50
12	Skunk	169.2	148	215	309	52.5	60	53	42
13	Iowa & Cedar	602.7	152	218	312	169.8	78	55	47
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	356.5	146	219	316	116.9	83	64	55
15	Cannon, Zumbro, & Root	202.6	146	201	278	71.6	85	65	53
16	Minnesota	276	136	177	242	168.5	76	63	57
	Basin Total	17,332/	143	197	273	1,984.0	73	55	47

machinery is shown as being the leading employer and nonelectrical machinery is No. 2, fabricated metals No. 3, food No. 4, transportation equipment No. 5, and primary metals No. 7. Several manufacturing industries are projected to show a decline in employment, as noted in *Table P-8*. The most significant water-using industries are the following: food, pulp and paper, chemicals, petroleum products, primary metals, and stone, clay and glass products. Of these industries the most rapidly growing one in terms of employment is the pulp and paper industry, as shown in *Table P-8*.

1.9.3 Personal Income

Total personal income and per capita income for 1960, and indexes of change by decade to 2020 are shown in *Table P-9*. The total personal income for the entire Basin of $46.6 billion in 1960 is projected to increase, at an index based on 1960 equals 100, as follows: 1980, 231; 2000, 500; 2020, 1065. This is based on average annual compound rates of change of income of slightly over 2 percent per year per capita which has been true in the past two decades based on real income on constant value for the dollar. Per capita income which was $2,410 in 1960 is projected to increase, at an index based on 1960 equals 100, to 170 in 1980, 273 in 2000, and 427 by 2020. The per capita income, based on 1960 dollars is projected to increase from $2,410 in 1960 to $4,105 in 1980, to $6,586 in 2000, and $10,281 in 2020. As one would suspect, the highest income areas are major metropolitan areas such as Illinois North, Mississippi Headwaters, Meramec, etc. The plan areas of lowest income but with some of the higher rates of change are the relatively rural agricultural areas. This is summarized in *Table P-10*.

1.9.4 Output by Selected Industries

To aid in the problem of projecting water resource requirements especially for manufacturing industries, data were developed for output for selected industries that were analyzed and deemed significant for water requirements in the Basin. This analysis was done prior to the organization of the Economic Base Study and represented the combined views of the Public Health Service (now FWPCA), the NPA, and the Corps of Engineers. Data on agricultural output, forestry output, and mining output were developed by Federal agencies as part of the information required to project water use in areas of their specific responsibility.

Table P-6

Employment in the Upper Mississippi River Basin by Plan Area With Indexes – 1960–2020

	Plan Area	Actual 1960	Projected 1980	2000	2020
Employees (thousands)					
1	Mississippi Headwaters	848.4	1,179.2	1,605.9	2,123.5
2	Chippewa & Black	99.4	128.5	164.5	205.5
3	Wisconsin	169.4	223.7	293.0	378.8
4	Rock	561.6	752.6	1,014.1	1,384.3
5A	Illinois, North	3,126.0	4,014.7	5,303.9	7,032.7
5B	Illinois, South	599.4	769.5	1,040.8	1,430.8
6	Kaskaskia	221.1	278.8	353.7	452.4
7	Big Muddy	65.8	83.3	105.7	134.6
8	Meramec	715.0	1,004.2	1,371.7	1,855.3
9	Salt	55.1	64.3	78.0	101.6
10	Fox, Wyaconda, & Fabius	18.3	22.2	27.8	36.1
11	Des Moines	302.8	403.9	530.3	699.2
12	Skunk	83.4	116.5	158.9	217.7
13	Iowa & Cedar	272.0	358.5	477.6	643.5
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	172.9	224.5	295.8	407.5
15	Cannon, Zumbro, & Root	99.3	132.0	177.2	223.3
16	Minnesota	142.7	163.4	195.5	244.2
	Basin Total	7,552.7	9,919.8	13,194.1	17,581.0
Indexes (based on 1960 = 100)					
1	Mississippi Headwaters	100	139	189	250
2	Chippewa & Black	100	129	165	207
3	Wisconsin	100	132	173	224
4	Rock	100	134	181	246
5A	Illinois, North	100	128	170	225
5B	Illinois, South	100	128	174	239
6	Kaskaskia	100	126	160	209
7	Big Muddy	100	127	161	204
8	Meramec	100	140	192	259
9	Salt	100	117	141	184
10	Fox, Wyaconda, & Fabius	100	121	152	197
11	Des Moines	100	133	175	231
12	Skunk	100	140	191	261
13	Iowa & Cedar	100	132	176	237
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	100	130	171	236
15	Cannon, Zumbro, & Root	100	133	178	225
16	Minnesota	100	114	137	171
	Basin Total	100	131	175	233

1.9.4.1 Manufacturing Output

A summary of the output indexes for selected manufacturing industries that are major water users or create water quality problems are shown in *Table P-11*. The industries included are food, chemicals, petroleum refining, hydraulic cement, primary metals, fabricated metals, and nonelectrical machinery.* The output is based on a value added concept on an employee basis and represents, for the future period, changes in output per employee, as projected by the NPA. As seen in *Table P-11*, the Illinois North plan area, which includes Chicago, accounts for about one half of the output of the selected manufacturing industries with the Illinois South, the Rock River, and the Meramec accounting for an additional one-fourth of the Basin output divided equally among those three areas. The Mississippi Headwaters ranks next on total output of these selected industries. The overwhelming predominance of output by the Illinois North Plan Area is shown for the food industry, chemicals, primary metals, fabricated metals, and nonelectrical machinery. In terms of the projected index of change shown for 1980, the index shows the

*For additional data refer to pages P-II-615-620, Draft No. 2 Appendix P, June 1968.

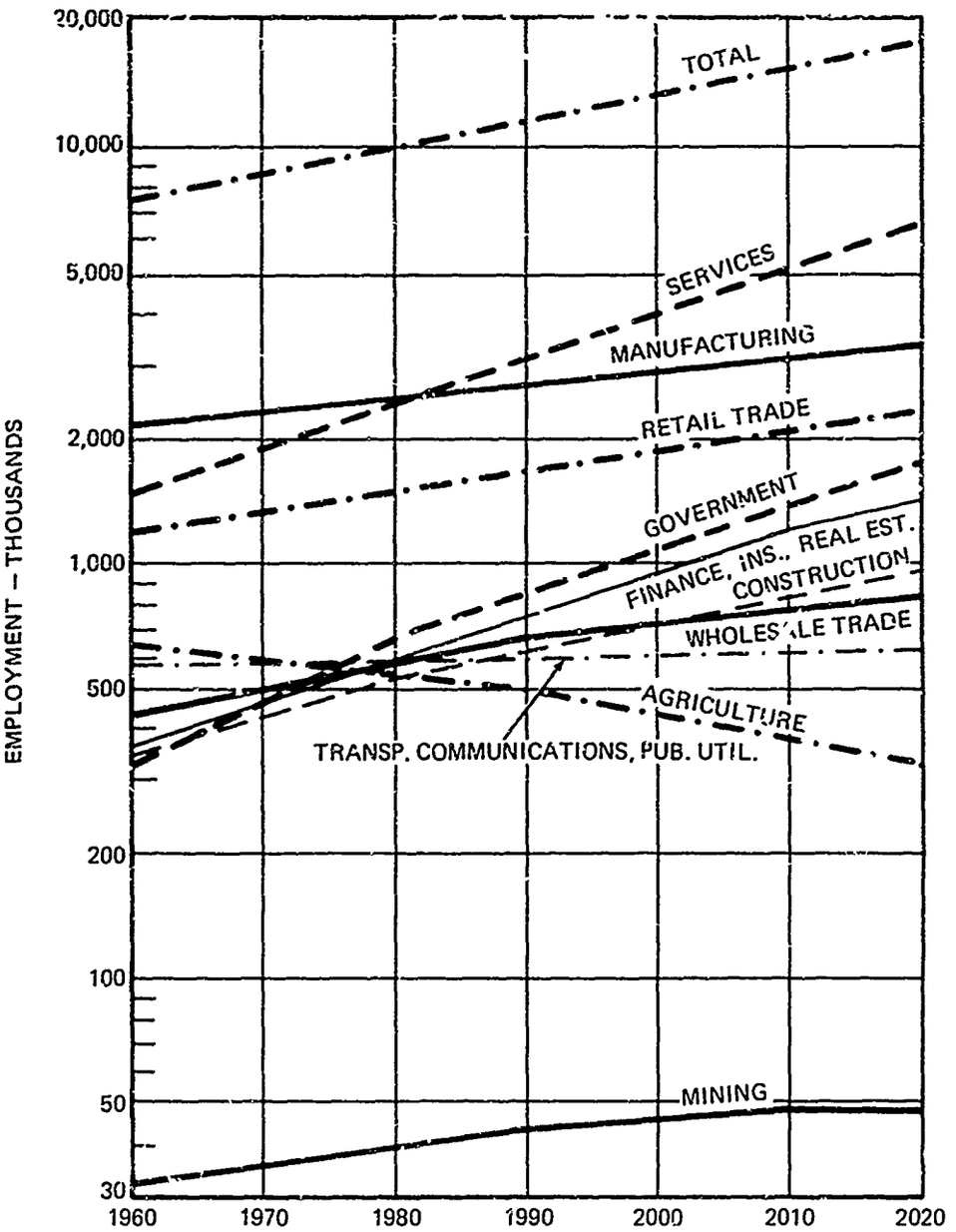

Figure P-5. Total employment in the Upper Mississippi River Basin plan areas by major industry group, 1960–2020.

Table P-7

Industry Employment Total for the Upper Mississippi River Basin by Major Sector Employment – 1960–2020, and Index

Major Sector		*Actual*	*Projected*		
SIC	*Descriptic.*	*1960*	*1980*	*7000*	*2020*
Employees (thousands)					
01-09	Agr., Forest. & Fisheries	619.7	530.5	421.6	337.5
10-14	Mining[a]	33.2	39.8	45.3	46.6
15-17	Construction	394.6	543.0	715.5	940.8
19-39	Manufacturing	2,149.8	2,439.7	2,792.2	3,226.7
40-49	Transp., Communications, Public Util.	588.9	597.1	599.3	620.6
50	Wholesale Trade	418.2	592.6	720.6	858.5
52-59	Retail Trade	1,196.8	1,426.7	1,767.3	2,247.9
60-67	Finance, Insurance, Real Estate	354.1	576.5	930.4	1,357.0
70-89	Services	1,461.8	2,508.7	4,162.7	6,282.2
91-93	Government	335.5	665.2	1,039.3	1,663.8
	Total	7,552.7	9,919.8	13,194.1	17,581.0
Indexes (based on 1960 = 100):					
01-09	Agr. Forest. & Fisheries	100	86	68	54
10-14	Mining[a]	100	120	136	140
15-17	Construction	100	138	181	238
19-39	Manufacturing	100	113	130	150
40-49	Transp., Communications, Public Util.	100	101	102	105
50	Wholesale Trade	100	142	172	205
52-59	Retail Trade	100	119	148	188
60-67	Finance, Insurance, Real Estate	100	163	263	383
70-89	Services	100	172	285	430
91-93	Government	100	198	310	496
	Total	100	131	175	233

[a] A sizeable amount of new mineral discoveries and workings have been added to mining activity since 1960. These new activities are reflected in the Bureau of Mines projections shown in Table P-85. However, because of the projection procedures for the economic subregions and allocation to the plan areas, the mining employment projections shown in this table are slightly less than those shown by the Bureau of Mines. The differences are small and do not affect the total employment.

highest change of output for the chemical industry, with hydraulic cement ranking second, petroleum refining third, food fourth, fabricated metals fifth, nonelectric machinery sixth, and primary metals seventh. The total output is shown as increasing 140 percent in the 20 years from 1960 to 1980. During this same period employment in manufacturing industries as a whole increased 13 percent. Employment data for the major water-using industries and the data on output was used by the Federal Water Pollution Control Administration in Appendix H to project the industrial water requirements and water quality needs. A combination of indexes of employment and output were generally used by FWPCA as indexes of industrial water requirements and related quality control problems.

1.9.4.2 Agricultural Production

The demand for agricultural production, including crop and livestock products, from the Basin shows the requirement for feed crops almost tripling, from 49 million tons in 1959 to 141 million tons in 2020. Food crops are projected to increase from 274 million bushels in 1959 to slightly over 1 billion bushels in 2020. Livestock products showed a high rate growth in beef and veal of three times from 1959 to 2020, milk two times, poultry about three times, and other agricultural products at similar rates. The value of crops in the Basin is projected to increase from $3 billion in 1959 to $6.9 billion in 2020. Livestock production is shown as increasing from $3.7 billion in 1959 to $9.4 billion in 2020. The total output of crops and livestock is projected to increase from 6.8 billion in 1959 to 16.3 billion in 2020. These projections are based on information furnished by the Economic Research Service, Department of Agriculture and are shown in detail in Section 3 of this appendix.

1.9.4.3 Forest Output

The United States Forest Service projects the output of forest products as increasing dramatically from 1960 to 2020. The timber products output is projected to increase approximately 4 times from 1960 to 2020 for saw logs

Table P-8

Manufacturing Employment and Index of Employment for the Upper Mississippi River Basin by Major Industry Group – 1960–2000

Major Industry Group		*Employees, thousands*			*Index, 1960 = 100*		
SIC Code	*Description*	*1960*	*1980*	*2000*	*1960*	*1980*	*2000*
19	Ordnance	12.9	11.3	11.1	100	88	86
20	Food	286.1	296.3	295.5	100	104	103
21	Tobacco	1.0	0.3	0.2	100	30	20
22	Textiles	18.4	10.8	7.6	100	59	41
23	Apparel	73.2	45.9	39.3	100	63	54
24	Lumber	35.4	31.8	30.1	100	90	85
25	Furniture	45.3	40.2	36.0	100	89	79
26	Pulp & Paper	66.6	80.5	101.9	100	121	153
27	Printing & Publishing	157.4	174.9	196.7	100	111	125
28	Chemicals	83.0	100.7	125.0	100	121	151
29	Petroleum Products	24.9	18.5	16.2	100	74	65
30	Rubber & Plastics	39.0	60.2	92.2	100	154	236
31	Leather Products	50.7	33.3	26.9	100	66	53
32	Stone, Clay, Glass	69.1	76.9	86.9	100	111	126
33	Primary Metals	182.8	192.3	193.1	100	105	106
34	Fabricated Metals	221.1	274.3	305.1	100	124	138
35	Nonelectrical Machinery	298.3	309.6	361.1	100	104	121
36	Electrical Machinery	237.7	337.5	438.7	100	142	185
37	Transportation Equipment	133.3	168.4	201.6	100	126	151
38	Instruments	61.3	109.6	152.7	100	179	249
39	Miscellaneous Manufacturing	51.7	66.2	73.5	100	128	142
	Total All Manufacturing	2,149.8	2,439.7	2,792.2	100	113	130

and about 2.5 times for pulp wood. Timber growth is projected to exceed timber cut during the entire projection period. Details by plan areas as well as economic subregions are shown in Section 4 of this appendix.

1.9.4.4 Mineral Production

The mineral industries of the Basin are projected to increase for selected major commodities such that the production of iron ore is projected to increase from about 14 million tons in 1960 to 42 million tons in 2020. Coal production is projected to increase from about 21 million tons in 1960 to 87 million tons in 2000 and a slight decline to 78 million tons in 2020. Output of sand and gravel is projected to increase substantially from 93 million tons in 1960 to 205 million tons in 1980 and 613 million tons in 2020. The other mineral industries are projected in Section 5 of this appendix by both plan areas and economic subregions.

1.9.4.5 Electric Power Generation

Electric power requirements by the power supply areas in the Basin were utilized in developing the projected requirements for coal production for selected areas in the Basin. The data on power requirements, as well as the type of fuel projected to be used by the power industry, are shown in Section 6 of this appendix and also in Appendix M, Power.

1.9.5 Plan Area Economic Profiles

Economic profiles for the total Basin (*Table P-12*) and for each plan area are organized by the four major economic factors which formed the basis for the entire economic base study, i.e., population, employment, income, and physical output. The projected share of the four components of the plan area economy is related to projected Basin totals in each profile for the purpose of comparing plan area growth with that of the entire Basin. The population segment of the profiles is a result of a combined effort by the NPA and the Economic Research Service of the Department of Agriculture which were responsible for nonfarm and farm population respectively. The data and projections of personal income, employment and output are summarized from Chapter V of the NPA report on

Table P-9

Upper Mississippi River Basin
Personal Income Data for Plan Areas – 1960
and Indexes of Personal Income – 1970–2020

	Plan Area	1960 Income, millions of dollars	Index, based on 1960 = 100					
			1970	1980	1990	2000	2010	2020
Total Personal Income:								
1	Mississippi Headwaters	4,694	160	249	376	564	847	1248
2	Chippewa & Black	508	154	230	345	516	769	1101
3	Wisconsin	878	161	243	367	552	827	1192
4	Rock	2,869	165	239	367	555	835	1237
5A	Illinois, North	21,254	154	222	318	460	669	961
5B	Illinois, South	3,633	156	243	365	553	830	1213
6	Kaskaskia	1,358	151	220	317	472	689	985
7	Big Muddy	370	148	218	307	451	653	927
8	Meramec	4,619	158	238	351	524	766	1099
9	Salt	258	141	202	283	412	592	828
10	Fox, Wyaconda, & Fabius	105	145	209	298	429	622	874
11	Des Moines	1,786	154	231	341	516	773	1065
12	Skunk	427	157	224	324	469	726	1074
13	Iowa & Cedar	1,647	154	232	344	500	756	1093
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	950	152	236	364	555	837	1226
15	Cannon, Zumbro, & Root	491	156	245	367	549	822	1200
16	Minnesota	716	153	233	343	492	725	1050
	Basin total	46,546	156	231	338	499	737	1065
Per Capita Income:								
1	Mississippi Headwaters	2,254	130	167	218	283	368	456
2	Chippewa & Black	1,635	139	187	250	325	429	540
3	Wisconsin	1 755	139	182	237	309	407	504
4	Rock	2,190	142	179	233	295	371	452
5A	Illinois, North	2,914	135	160	193	244	306	374
5B	Illinois, South	2,059	138	190	244	318	407	499
6	Kaskaskia	1,902	134	176	226	300	389	482
7	Big Muddy	1,857	137	182	234	308	400	488
8	Meramec	2,478	134	173	215	273	346	423
9	Salt	1,577	139	185	232	297	379	462
10	Fox, Wyaconda, & Fabius	1,560	135	197	236	304	389	473
11	Des Moines	2,114	135	176	225	295	390	462
12	Skunk	1,925	139	173	215	277	354	437
13	Iowa & Cedar	2,133	131	171	219	275	354	430
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	2,066	134	181	238	307	395	490
15	Cannon, Zumbro, & Root	1,793	137	188	252	331	433	547
16	Minnesota	1,617	143	205	279	368	486	613
	Basin total	2,410	135	170	214	273	347	427

economic and demographic changes published in Draft No. 2 of Appendix P. The data shown in *Table P-12* through *P-46* do not reflect the refinements of employment developed in Sections 3, 4, and 5 for the physical resource industries of agriculture, forestry and mining. Some of the resource industries information on employment is based on slightly different definitions and allocation procedures, but these do not significantly affect the total employment for any of the plan areas. Employment projections have been broken down into commodity and noncommodity groupings. The major components of the noncommodity sector are retail trade and services which are not directly related to water and land resources development. The commodity producing employment is further subdivided into manufacturing and nonmanufacturing categories. The nonmanufacturing activities are agriculture, forestry, and mining. Manufacturing consists of employment in two-digit SIC major groups 19 through 39. Separate selected employment and output data and projections are reported in *Tables P-13* through *P-46* for manufacturing industries classified as major water consumers and/or requiring a large volume of water for dilution of waste discharge. Growth of employment and output in these selected categories is seen as presenting a disproportionate need for water supply and water quality in comparison to other employment sectors. *Table P-47* is a composite listing of projected indexes of change in total population, total employment, total income, selected manufacturing employment, and selected manufacturing output for the Basin and all plan areas.

Table P-10

Per Capita Personal Income by Plan Area, Upper Mississippi River Basin — 1960 and 2020 (1960 dollars)

Per Capita Personal Income, 1960				*Per Capita Personal Income, 2020*			
Rank	*Area No.*	*Plan Area*	*Amount, dollars*	*Rank*	*Area No.*	*Plan Area*	*Amount, dollars*
1	5A	Illinois, North	2,914	1	5A	Illinois, North	10,911
2	8	Meramec	2,478	2	8	Meramec	10,488
3	1	Mississippi Headwaters	2,264	3	1	Mississippi Headwaters	10,335
4	4	Rock	2,190	4	5B	Illinois, South	10,274
5	13	Iowa & Cedar	2,133	5	4	Rock	9,905
6	11	Des Moines	2,114	6	16	Minnesota	9,905
7	5B	Illinois, South	2,059	7	14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	9,832
8	14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	2,006	8	15	Cannon, Zumbro, & Root	9,817
9	12	Skunk	1,925	9	11	Des Moines	9,777
10	6	Kaskaskia	1,902	10	13	Iowa & Cedar	9,165
11	15	Cannon, Zumbro, & Root	1,793	11	6	Kaskaskia	9,160
12	3	Wisconsin	1,755	12	3	Wisconsin	8,845
13	7	Big Muddy	1,657	13	2	Chippewa & Black	8,808
14	2	Chippewa & Black	1,630	14	12	Skunk	8,418
15	16	Minnesota	1,617	15	7	Big Muddy	8,080
16	9	Salt	1,572	16	10	Fox, Wyaconda, & Fabius	7,379
17	10	Fox, Wyaconda, & Fabius	1,560	17	9	Salt	7,259
		Basin Total	2,410			Basin Total	10,281

Table P-11

Upper Mississippi River Basin Output (Value Added) for Selected Manufacturing Industries by Plan Area — 1960, and Index for 1980

	Plan Area	Selected Manufacturing Industries, SIC No. and name							
		20 Food	*28 Chem.*	*291 Pet. Ref.*	*324 Hy. Cem.*	*33 Prim. Met.*	*34 Fabr. Met.*	*35 Non-elec. Mach.*	*Total Sel.*
Amount (millions of 1960 dollars)									
1	Mississippi Headwaters	464.1	96.8	11.2	[a]	23.5	124.2	263.1	983.1
2	Chippewa & Black	47.2	[a]	–	–	[a]	[a]	[a]	58.4
3	Wisconsin	54.2	[a]	–	–	[a]	16.4	56.5	135.7
4	Rock	207.5	43.6	–	[a]	94.6	521.9	452.6	1,325.3
5A	Illinois, North	1,526.8	1,096.6	222.6	29.3	1,760.3	1,343.7	1,481.8	7,461.1
5B	Illinois, South	354.9	100.2	[a]	22.7	89.2	106.2	684.5	1,365.3
6	Kaskaskia	118.8	90.4	104.2	–	220.3	30.1	28.7	592.5
7	Big Muddy	15.4	[a]	–	–	[a]	[a]	[a]	23.7
8	Meramec	407.8	316.6	[a]	18.8	63.3	175.9	193.4	1,176.0
9	Salt	[a]	7.3	–	[a]	[a]	[a]	[a]	37.0
10	Fox, Wyaconda, & Fabius	[a]	–	–	–	[a]	[a]	[a]	[a]
11	Des Moines	136.1	23.3	–	11.3	11.8	22.0	100.4	304.9
12	Skunk	19.5	[a]	–	–	[a]	[a]	24.8	62.6
13	Iowa & Cedar	218.2	38.3	–	28.0	[a]	56.1	185.3	531.8
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	214.5	32.8	–	–	52.4	21.2	61.6	382.5
15	Cannon, Zumbro, & Root	45.4	[a]	–	–	[a]	12.5	30.6	94.8
16	Minnesota	81.3	[a]	–	–	[a]	[a]	10.7	99.8
	Total Selected Mfg. Ind.	3,922.5	1,873.1	346.7	122.4	2,337.5	2,457.1	3,588.9	14,648.2
Index of Change for 1980 (based on 1960 = 100):									
1	Mississippi Headwaters	247	489	377	[a]	215	264	264	284
2	Chippewa & Black	251	[a]	–	–	[a]	[a]	[a]	268
3	Wisconsin	269	[a]	–	–	[a]	226	416	322
4	Rock	253	263	–	[a]	156	260	169	220
5A	Illinois, North	234	331	280	368	192	228	183	229
5B	Illinois, South	242	345	[a]	283	273	270	177	222
6	Kaskaskia	239	353	199	–	210	222	254	240
7	Big Muddy	280	[a]	–	–	[a]	[a]	[a]	278
8	Meramec	297	354	[a]	231	214	235	456	324
9	Salt	[a]	389	–	[a]	[a]	[a]	[a]	307
10	Fox, Wyaconda, & Fabius	[a]	–	–	–	[a]	[a]	[a]	[a]
11	Des Moines	220	279	–	321	167	309	182	220
12	Skunk	221	[a]	–	–	[a]	[a]	173	200
13	Iowa & Cedar	213	296	–	321	[a]	304	175	221
14	Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	242	224	–	–	230	210	167	225
15	Cannon, Zumbro, & Root	246	[a]	–	–	[a]	239	363	286
16	Minnesota	250	[a]	–	–	[a]	[a]	266	259
	Total Selected Mfg. Ind.	244	340	260	302	197	241	209	240

[a] Output data are not shown for areas and industries that had less than $10,000,000 of value added by manufacture calculated for 1960.

Table P-12

Economic Profile of the Upper Mississippi River Basin

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	19,317	100	17,333	100	1,984	100	46,564	100	2,410	100
1980	26,153	100	24,707	100	1,446	100	107,366	100	4,105	100
2000	35,309	100	34,217	100	1,052	100	232,555	100	6,586	100
2020	48,229	100	47,304	100	925	100	495,844	100	10,281	100

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	7,553	100	4,750	100	2,803	100	2,150	653
1980	9,920	100	6,910	100	3,010	100	2,440	570
2000	13,194	100	9,935	100	3,259	100	2,792	467
2020	17,581	100	13,970	100	3,611	100	3,227	384

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 - Food	28 - Chem.	29 - Petrol. Prod.	32 - Stone, Clay, Glass	33 - Primary Metals	34, 35 - Fabr. Met. & Nonelec. Mach	Total
1960	286	83	25	69	183	520	1,166
1980	296	101	19	77	192	584	1,269
2000	296	125	16	87	193	667	1,384

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 - Food	28 - Chem.	291 - Petrol. Ref.	324 - Hyd. Cem.	33 - Primary Metals	34, 35 Fabr. Met & Nonelec. Mach.	Total
1960	3,923	1,873	347	122	2,338	6,046	14,649
1980	9,573	6,383	902	369	4,596	13,588	35,411

[a] Noncommodity group includes the following SIC categories: 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities, 50 Wholesale Trade, 52–59 Retail Trade, 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories: 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel, 24 Lumber, 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics, 31 Leather Products, 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery, 36 Electrical Equipment, 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing

Table P-13

Economic Data by County for Plan Area 1, Mississippi Headwaters

County Name	State Name	Population 1960 Urban	Population 1960 Total	Population 1950 Total	Population 1940 Total	Land Area (sq. miles)
Aitkin	Minnesota		12,152	14,327	17,865	1,824
Anoka[3]	Minnesota	76,468	85,916	35,579	22,443	425
Benton	Minnesota	7,247	17,287	15,911	16,106	404
Carver	Minnesota	2,501	21,358	18,155	17,606	358
Cass	Minnesota		16,720	19,468	20,646	2,053
Chisago	Minnesota		13,419	12,669	13,124	419
Crow Wing	Minnesota	15,527	32,134	30,875	30,226	999
Dakota[3]	Minnesota	52,935	78,203	49,019	39,650	571
Hennepin[3]	Minnesota	927,219	842,854	676,579	568,899	955
Hubbard	Minnesota	3,047	9,962	11,285	11,065	932
Isanti	Minnesota	2,728	13,530	12,123	12,950	442
Itasca	Minnesota	7,265	38,006	33,321	32,996	2,663
Kanabec	Minnesota		9,007	9,192	9,651	525
Kandiyohi	Minnesota	10,417	29,987	28,644	26,524	824
McLeod	Minnesota	9,423	24,401	22,195	21,380	498
Meeker	Minnesota	5,078	18,887	18,966	19,277	620
Mille Lacs	Minnesota		14,560	15,165	15,558	568
Morrison	Minnesota	7,551	26,641	25,832	27,473	1,136
Pine	Minnesota		17,004	18,223	21,478	1,412
Ramsey[3]	Minnesota	417,322	422,525	355,332	309,935	160
Scott	Minnesota	6,815	21,909	16,486	15,585	352
Sherburne	Minnesota	3,166	12,861	10,661	10,456	438
Stearns	Minnesota	31,013	80,345	70,681	67,200	1,356
Todd	Minnesota	2,706	23,119	25,420	27,438	947
Wadena	Minnesota	4,381	12,199	12,806	12,772	536

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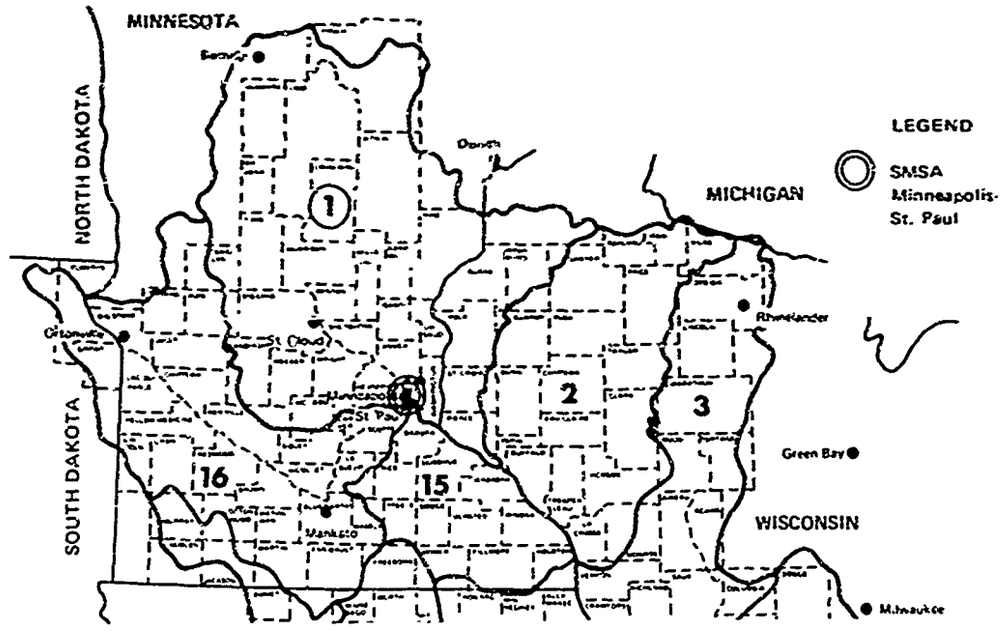

Figure P-6. Upper Mississippi River Basin Plan Area No. 1.

Table P-13 (con.)

County Name	State Name	Population 1960 Urban	Population 1960 Total	Population 1950 Total	Population 1940 Total	Land Area (sq. miles)
Washington[a]	Minnesota	23,699	52,432	34,544	26,430	390
Wright	Minnesota		29,935	27,716	27,550	671
Burnett	Wisconsin		9,214	10,236	11,382	840
Pierce	Wisconsin	4,232	22,503	21,448	21,471	591
Polk	Wisconsin		24,968	24,944	26,197	934
St. Croix	Wisconsin	8,266	29,164	25,905	24,842	736
Washburn	Wisconsin		10,301	11,665	12,496	816
Total		1,528,986	2,073,613	1,715,175	1,538,701	26,005

[a] Minneapolis-St. Paul, Minn. SMSA

Table P-14

Economic Profile of Plan Area 1, Mississippi Headwaters

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	2,074	10.7	1,854	10.7	219	11.0	4,694	10.1	2,264	94
1980	3,098	11.8	2,953	12.0	146	10.1	11,695	10.9	3,775	92
2000	4,126	11.7	4,022	11.8	104	9.6	26,478	11.4	6,417	97
2020	5,671	11.7	5,578	11.8	93	10.0	58,610	11.8	10,335	101

	Employment, thousand							
Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	948	11.2	607	12.8	242	8.6	173	69
1980	1,179	11.9	885	12.8	294	9.8	234	60
2000	1,605	12.2	1,254	12.6	351	10.8	300	51
2020	2,124	12.1	1,715	12.3	409	11.3	368	41

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 - Food	28 - Chem.	29 - Petrol. Prod.	32 - Stone, Clay, Glass	33 - Primary Metals	34, 35 - Fabr. Met. & Nonelec. Mach.	Total
1960	35	4	1	4	3	38	85
1980	37	7	1	5	3	53	106
2000	37	9	1	5	3	71	126

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 - Food	28 - Chem.	291 - Petrol. Ref.	324 - Hyd. Cemt.	33 - Primary Metals	34, 35 - Fabr. Met. & Nonelec. Mach.	Total
1960	464	97	11	[c]	24	387	983
1980	1,146	474	42	1	50	1,077	2,790

[a] Noncommodity group includes the following SIC categories 15–17 Construction; 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate; 70–89 Services; and 91–93 Government.

[b] Commodity group includes SIC categories. 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles; 23 Apparel; 24 Lumber; 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics; 31 Leather Products, 32 Stone, Clay, and Glass; 33 Primary Metals; 34 Fabricated Metals, 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment; 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than $500,000.

Table P-15

Economic Data by County for

Plan Area 2, Chippewa and Black Rivers

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Barron	Wisconsin	7,303	34,270	34,703	34,289	888
Buffalo	Wisconsin		14,202	14,719	16,090	712
Chippewa	Wisconsin	15,266	45,096	42,839	40,703	1,025
Clark	Wisconsin	2,728	31,527	32,459	33,972	1,222
Dunn	Wisconsin	8,624	26,156	27,241	27,375	858
Eau Claire	Wisconsin	37,263	58,300	54,187	45,999	649
Jackson	Wisconsin	3,195	15,151	16,073	16,599	1,000
Pepin	Wisconsin		7,332	7,462	7,897	237
Price	Wisconsin	2,919	14,370	16,344	18,467	1,268
Rusk	Wisconsin	3,584	14,794	16,790	17,737	910
Sawyer	Wisconsin		9,475	10,323	11,540	1,273
Taylor	Wisconsin	3,260	17,843	18,456	20,105	979
Trempealeau	Wisconsin		23,377	23,730	24,381	739
Total		84,142	311,893	315,426	316,154	11,733

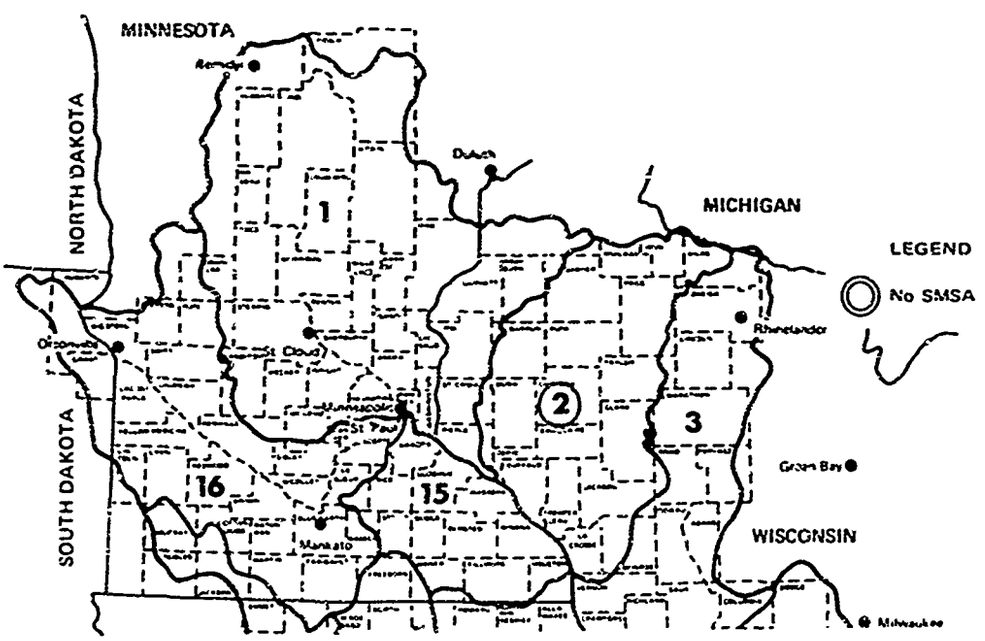

Figure P-7. Upper Mississippi River Basin Plan Area No. 2.

Table P-16

Economic Profile of Plan Area 2, Chippewa and Black Rivers

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	312	1.6	206	1.2	106	5.3	508	1.1	1,630	68
1980	383	1.5	308	1.2	75	5.2	1,169	1.1	3,054	74
2000	495	1.4	440	1.3	55	5.0	2,623	1.1	5,298	80
2020	635	1.3	586	1.2	49	5.3	5,593	1.1	8,808	86

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	99	1.3	50	1.1	49	1.7	16	33
1980	129	1.3	77	1.1	52	1.7	24	28
2000	165	1.3	109	1.1	56	1.7	34	22
2020	206	1.2	144	1.0	62	1.7	45	17

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	5	[c]	–	1	[c]	2	8
1980	5	[c]	–	1	[c]	2	8
2000	5	[c]	–	1	[c]	3	9

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	47	[d]	–	–	[d]	11	58
1980	119	[d]	–	–	[d]	57	176

[a] Noncommodity group includes the following SIC categories: 15–17 Construction; 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate; 70–89 Services; and 91–93 Government.

[b] Commodity group includes SIC categories: 01–19 Agriculture; 10–14 Mining; 19 Ordnance; 20 Food; 21 Tobacco; 22 Textiles; 23 Apparel; 24 Lumber; 25 Furniture; 26 Pulp and Paper; 27 Printing and Publishing, 28 Chemicals; 29 Petroleum Products, 30 Rubber and Plastics; 31 Leather Products; 32 Stone, Clay and Glass; 33 Primary Metals; 34 Fabricated Metals, 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment; 38 Instruments; and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 Employees.

[d] Less than $500,000.

Table P-17

Economic Data by County for
Plan Area 3, Wisconsin River

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Adams	Wisconsin		7,565	7,906	8,449	677
Columbia	Wisconsin	11,289	36,708	34,023	32,517	778
Crawford	Wisconsin	5,649	16,351	17,652	18,328	586
Juneau	Wisconsin	3,531	17,490	18,930	18,708	795
La Crosse	Wisconsin	50,736	72,465	67,587	59,653	469
Lincoln	Wisconsin	12,799	22,338	22,235	22,536	900
Marathon	Wisconsin	41,636	88,874	80,337	75,915	1,584
Monroe	Wisconsin	11,401	31,241	31,378	30,080	915
Oneida	Wisconsin	8,790	22,112	20,648	18,938	1,114
Portage	Wisconsin	17,837	36,964	34,858	35,800	810
Richland	Wisconsin	4,746	17,684	19,245	20,381	584
Sauk	Wisconsin	11,043	36,179	38,120	33,700	840
Vernon	Wisconsin	3,926	25,663	27,906	29,940	805
Vilas	Wisconsin		9,332	9,363	8,894	867
Wood	Wisconsin	31,710	59,105	50,500	44,465	812
Total		215,093	500,072	480,688	458,304	12,536

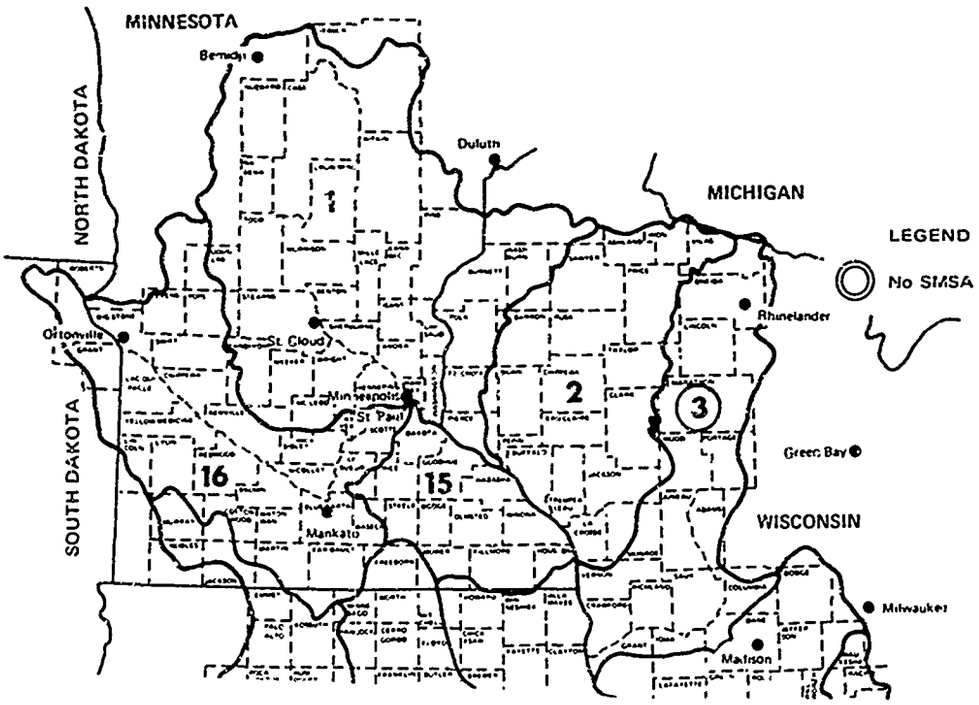

Figure P-8. Upper Mississippi River Basin Plan Area No. 3.

Table P-18

Economic Profile of Plan Area 3, Wisconsin River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	500	2.6	383	2.2	117	5.9	878	1.9	1,755	73
1980	669	2.6	591	2.4	78	5.4	2,137	2.0	3,194	78
2000	894	2.5	830	2.4	64	5.9	4,851	2.1	5,424	82
2020	1,184	2.4	1,125	2.4	59	6.4	10,471	2.1	8,845	86

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	169	2.2	92	1.9	77	2.7	41	36
1980	224	2.2	143	2.1	81	2.7	50	31
2000	293	2.2	205	2.1	88	2.7	64	24
2020	379	2.2	278	2.0	101	2.8	81	20

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	5	(c)	(c)	1	(c)	8	14
1980	6	(c)	(c)	1	(c)	13	20
2000	6	(c)	(c)	1	(c)	18	25

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1950 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	54	6	–	–	2	72	134
1980	146	22	–	–	4	423	595

[a] Noncommodity group includes the following SIC categories: 15–17 Construction; 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate; 70–89 Services; and 91–93 Government.

[b] Commodity group includes SIC categories: 01–09 Agriculture; 10–14 Mining; 19 Ordnance; 20 Food; 21 Tobacco; 22 Textiles; 23 Apparel; 24 Lumber; 25 Furniture; 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products; 30 Rubber and Plastics; 31 Leather Products; 32 Stone, Clay, and Glass; 33 Primary Metals; 34 Fabricated Metals; 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment; 38 Instruments; and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-19
Economic Data by County for Plan Area 4, Rock River

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Dane[a]	Wisconsin	137,377	222,095	169,357	130,660	1,197
Dodge	Wisconsin	29,538	63,170	57,611	54,280	892
Grant	Wisconsin	13,268	44,419	41,460	40,639	1,168
Green	Wisconsin	8,050	25,851	24,172	23,146	586
Iowa	Wisconsin	2,911	19,631	19,610	20,595	761
Jefferson	Wisconsin	25,382	50,094	43,069	38,868	564
Lafayette	Wisconsin		18,142	18,137	18,695	643
Rock	Wisconsin	79,343	113,913	92,778	80,173	721
Boone[b]	Illinois	11,223	20,326	17,070	15,202	283
Carroll	Illinois	4,950	19,507	18,975	17,987	468
De Kalb	Illinois	29,289	51,714	40,781	34,388	636
Henderson	Illinois		8,237	8,416	8,949	381
Henry[c]	Illinois	27,230	49,317	46,492	43,798	826
Jo Daviess	Illinois	6,492	21,821	21,459	19,989	614
Lee	Illinois	19,565	38,749	36,451	34,604	729
Mercer	Illinois	3,080	17,149	17,374	17,701	556
Ogle	Illinois	16,366	38,106	33,429	29,869	757
Rock Island[c]	Illinois	126,158	150,991	133,558	113,323	420
Stephenson	Illinois	26,628	46,207	41,595	40,646	568
Warren	Illinois	10,372	21,587	21,981	21,286	542
Whiteside	Illinois	33,495	59,887	49,336	43,333	690
Winnebago[b]	Illinois	175,462	209,765	152,385	121,178	520
Total		810,179	1,310,678	1,105,497	969,314	14,522

[a] Madison, Wisc. SMSA
[b] Rockford, Ill. SMSA
[c] Davenport-Rock Island-Moline, Ill.-Iowa SMSA (Illinois Part)

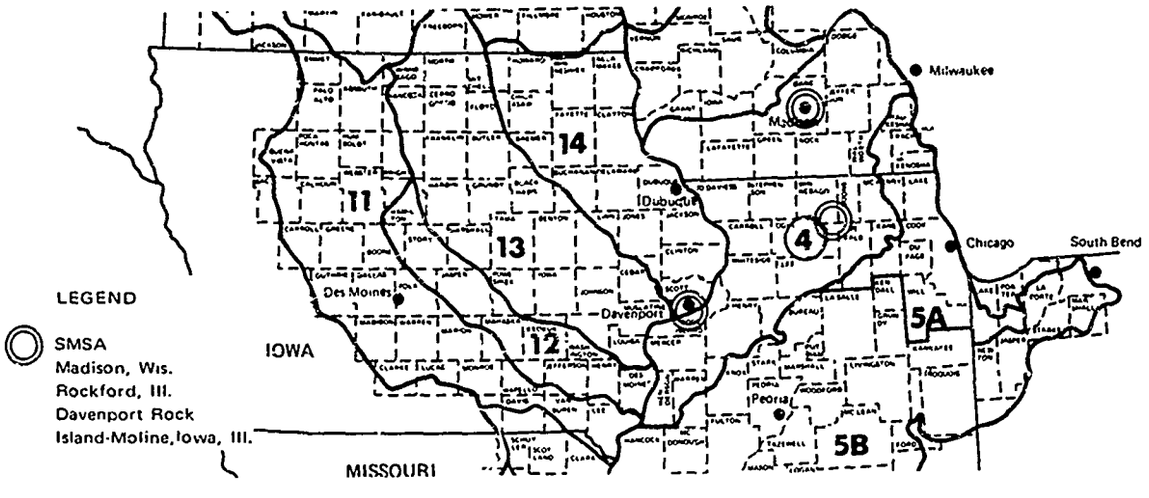

Figure P-9. Upper Mississippi River Basin Plan Area No. 4.

Table P-20

Economic Profile of Plan Area 4, Rock River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	1,311	6.8	1,114	6.4	197	9.9	2,869	6.2	2,190	91
1980	1,752	6.7	1,594	6.5	159	11.0	6,855	6.4	3,913	95
2000	2,455	7.0	2,341	6.8	113	10.3	15,912	6.8	6,483	98
2020	3,583	7.4	3,496	7.4	87	9.4	35,489	7.2	9,905	96

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	562	7.4	311	6.5	251	9.0	186	65
1980	753	7.6	479	6.9	274	9.1	218	56
2000	1,014	7.7	713	7.2	301	9.2	256	45
2020	1,384	7.9	1,053	7.5	331	9.2	293	38

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	18	3	[c]	2	8	83	114
1980	19	2	[c]	3	7	93	124
2000	19	2	[c]	4	7	97	129

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	208	44	–	5	95	975	1,327
1980	526	114	–	11	148	2,132	2,931

[a] Noncommodity group includes the following SIC categories: 15–17 Construction; 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories: 01–09 Agriculture; 10–14 Mining; 19 Ordnance; 20 Food; 21 Tobacco; 22 Textiles; 23 Apparel; 24 Lumber; 25 Furniture; 26 Pulp and Paper; 27 Printing and Publishing; 28 Chemicals; 29 Petroleum Products, 30 Rubber and Plastics; 31 Leather Products; 32 Stone, Clay, and Glass; 33 Primary Metals; 34 Fabricated Metals. 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment; 38 Instruments; and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-21

Economic Data by County for Plan Area 5A, Illinois River, North

County Name	State Name	Population 1960 Urban	Population 1960 Total	Population 1950 Total	Population 1940 Total	Land Area (sq. miles)
Kenosha[a]	Wisconsin	72,852	100,615	75,238	63,505	273
Racine[b]	Wisconsin	102,987	141,781	109,585	94,047	337
Walworth	Wisconsin	19,741	52,368	41,584	33,103	560
Washington[c]	Wisconsin	15,596	46,119	33,902	28,430	428
Waukesha[c]	Wisconsin	103,002	158,249	85,901	62,744	555
Cook[d]	Illinois	5,077,186	5,129,725	4,508,792	4,063,342	954
DuPage[d]	Illinois	268,714	313,459	154,599	103,420	331
Kane[d]	Illinois	171,594	208,246	150,388	130,206	516
Lake[d]	Illinois	230,074	293,656	179,097	121,094	457
McHenry[d]	Illinois	34,436	84,210	50,656	37,311	611
Will[d]	Illinois	135,565	191,617	134,336	114,210	845
Lake[e]	Indiana	480,386	513,269	368,152	293,195	514
Porter[e]	Indiana	32,331	60,279	40,076	27,836	425
Total		6,743,864	7,293,593	5,932,306	5,172,503	6,607

[a] Kenosha, Wis. SMSA
[b] Racine, Wis. SMSA
[c] Milwaukee, Wis. SMSA (Part)
[d] Chicago, Ill. SMSA
[e] Gary-Hammond-East Chicago, Ind. SMSA

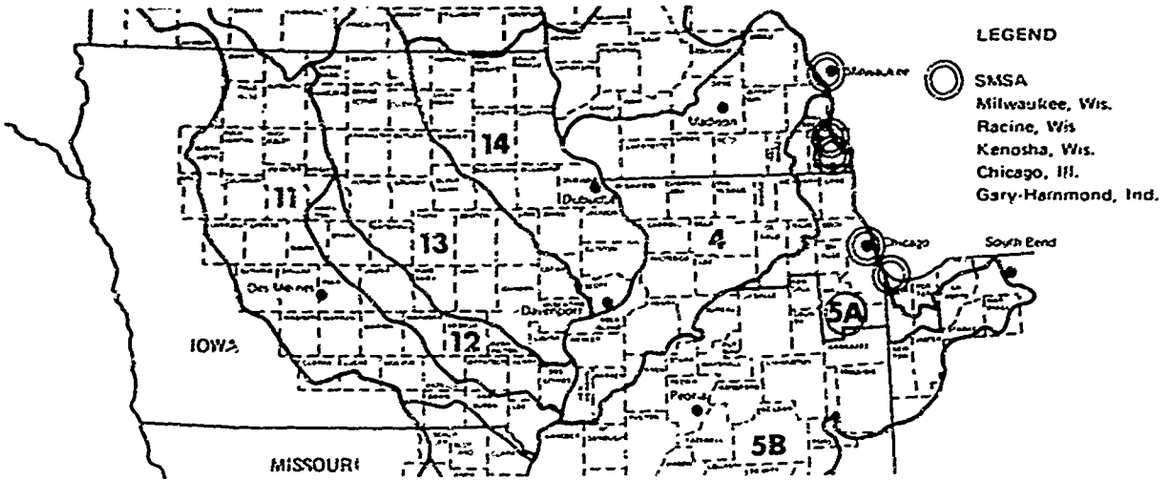

Figure P-10. Upper Mississippi River Basin Plan Area No. 5A.

Table P-22

Economic Profile of Plan Area 5A, Illinois River, North

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	7,294	37.8	7,213	41.6	81	4.1	21,254	45.6	2,914	121
1980	10,086	38.6	10,043	40.6	43	3.0	47,102	43.9	4,670	1[illegible]
2000	13,741	38.9	13,718	40.1	23	2.1	97,757	42.0	7,114	102
2020	18,721	38.7	18,710	39.6	14	1.5	204,300	41.2	10,911	106

Employment, thousand								
Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	3,126	41.4	2,030	42.7	1,096	39.1	1,057	39
1980	4,015	40.5	2,828	40.9	1,187	39.4	1,148	39
2000	5,304	40.2	4,026	40.5	1,278	39.2	1,241	37
2020	7,033	40.0	5,639	40.4	1,394	38.6	1,362	32

Employment for Selected Manufacturing Industries by SIC, thousand							
Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	101	45	17	25	135	242	565
1980	104	53	13	30	140	253	593
2000	104	64	11	36	136	263	614

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars							
Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	1,527	1,097	223	29	1,760	2,826	7,462
1980	3,571	3,634	622	108	3,379	5,771	17,085

[a] Noncommodity group includes the following SIC categories. 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade, 52–59 Retail Trade, 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories. 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel; 24 Lumber; 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics; 31 Leather Products, 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery; 36 Electrical Equipment, 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

Table P-23
Economic Data by County for
Plan Area 5B, Illinois River, South

County Name	State Name	Population 1960 Urban	Population 1960 Total	Population 1950 Total	Population 1940 Total	Land Area (sq. miles)
Adams	Illinois	43,793	68,467	64,690	65,229	866
Brown	Illinois		6,210	7,132	8,053	307
Bureau	Illinois	11,621	37,594	37,711	37,600	868
Calhoun	Illinois		5,933	6,898	8,207	259
Cass	Illinois	6,294	14,539	15,097	16,425	370
Christian	Illinois	15,233	37,207	38,816	38,564	709
De Witt	Illinois	7,355	17,253	16,894	18,244	399
Ford	Illinois	7,823	16,606	15,901	15,007	488
Fulton	Illinois	19,022	41,954	43,716	44,627	874
Greene	Illinois	5,570	17,460	18,852	20,292	543
Grundy	Illinois	10,787	22,350	19,217	18,398	432
Hancock	Illinois	3,325	24,574	25,790	26,297	797
Iroquois	Illinois	5,219	33,562	32,348	32,496	1,122
Jersey	Illinois	7,420	17,023	15,264	13,636	374
Kankakee	Illinois	45,230	92,063	73,524	60,877	680
Kendall	Illinois	3,343	17,540	12,115	11,105	320
Knox	Illinois	43,272	61,280	54,366	52,250	728
La Salle	Illinois	73,290	110,800	100,610	97,801	1,152
Livingston	Illinois	14,517	40,341	37,809	38,838	1,043
Logan	Illinois	16,890	33,656	30,671	29,438	622
McDonough	Illinois	15,845	28,928	28,199	26,944	582
McLean	Illinois	49,628	83,877	76,577	73,930	1,173
Macon[a]	Illinois	89,516	118,257	98,853	84,693	576
Macoupin	Illinois	16,546	43,524	44,210	46,304	872
Marshall	Illinois		13,334	13,025	13,179	395
Mason	Illinois	4,363	15,193	15,326	15,353	541
Menard	Illinois		9,248	9,639	10,633	312
Morgan	Illinois	21,690	36,571	35,568	36,378	565
Peoria[b]	Illinois	154,114	189,044	174,347	153,374	624
Piatt	Illinois	3,219	14,960	13,970	14,659	437
Pike	Illinois	4,089	20,552	22,155	25,340	829
Putnam	Illinois		4,570	4,746	5,289	166
Sangamon[c]	Illinois	111,403	146,539	131,484	117,912	880

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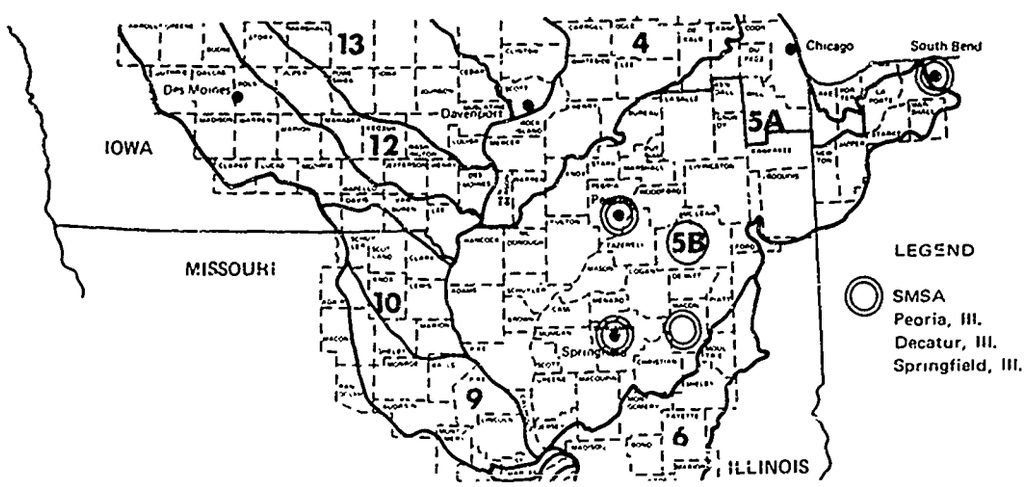

Figure P-11. Upper Mississippi River Basin Plan Area No. 5B.

Table P-23 (con.)

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Schuyler	Illinois	2,819	8,746	9,613	11,420	434
Scott	Illinois		6,377	7,245	8,176	251
Stark	Illinois		8,152	8,721	8,831	291
Tazewell[b]	Illinois	69,762	99,789	76,165	58,362	653
Woodford[b]	Illinois	2,538	24,579	21,335	19,124	537
Jasper	Indiana	4,740	18,842	17,031	14,397	561
La Porte	Indiana	57,810	95,111	76,808	63,660	608
Marshall[d]	Indiana	10,620	32,443	29,468	25,935	444
Newton	Indiana		11,502	11,006	10,775	411
Starke	Indiana	3,458	17,911	15,282	12,258	311
Total		962,164	1,764,461	1,608,194	1,510,405	25,407

[a] Decatur, Ill. SMSA
[b] Peoria, Ill. SMSA
[c] Springfield, Ill. SMSA
[d] South Bend, Ind. SMSA (Part)

Table P-24

Economic Profile of Plan Area 5B, Illinois River, South

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	1,764	9.1	1,509	8.7	255	12.9	3,633	7.8	2,059	85
1980	2,260	8.6	2,077	8.4	183	12.7	8,842	8.2	3,913	95
2000	3,067	8.7	2,924	8.5	143	13.1	20,084	8.6	6,548	99
2020	4,290	8.9	4,178	8.8	112	12.1	44,072	8.9	10,274	100

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	599	7.9	358	7.5	241	8.6	159	82
1980	770	7.8	523	7.6	247	8.2	176	71
2000	1,041	7.9	768	7.7	273	8.4	215	58
2020	1,431	8.1	1,105	7.9	326	9.0	276	50

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	23	5	1	11	7	58	105
1980	24	6	1	12	10	61	114
2000	24	8	1	13	12	82	140

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	354	100	9	23	89	791	1,366
1980	857	347	30	64	243	1,495	3,036

[a] Noncommodity group includes the following SIC categories 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities, 50 Wholesale Trade, 52–59 Retail Trade, 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel, 24 Lumber, 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics, 31 Leather Products, 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery, 36 Electrical Equipment, 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

Table P-25
Economic Data by County for
Plan Area 6, Kaskaskia River

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Bond	Illinois	4,569	14,060	14,157	14,540	383
Clinton	Illinois	3,360	24,029	22,594	22,912	498
Fayette	Illinois	5,537	21,946	24,582	29,159	718
Madison[a]	Illinois	161,258	224,683	182,307	149,349	731
Marion	Illinois	19,592	39,349	41,700	47,989	580
Monroe	Illinois	6,913	15,507	13,282	12,754	380
Montgomery	Illinois	11,562	31,244	32,460	34,499	706
Moultrie	Illinois	3,946	13,635	13,171	13,477	345
Randolph	Illinois	7,912	29,986	31,673	33,608	594
St. Clair[a]	Illinois	214,636	262,509	205,995	166,899	670
Shelby	Illinois	4,821	23,404	24,434	26,290	772
Washington	Illinois	2,606	13,569	14,460	15,801	565
Total		446,732	3,929	620,815	567,277	6,942

[a] St. Louis, Mo. Ill SMSA (Illinois Part)

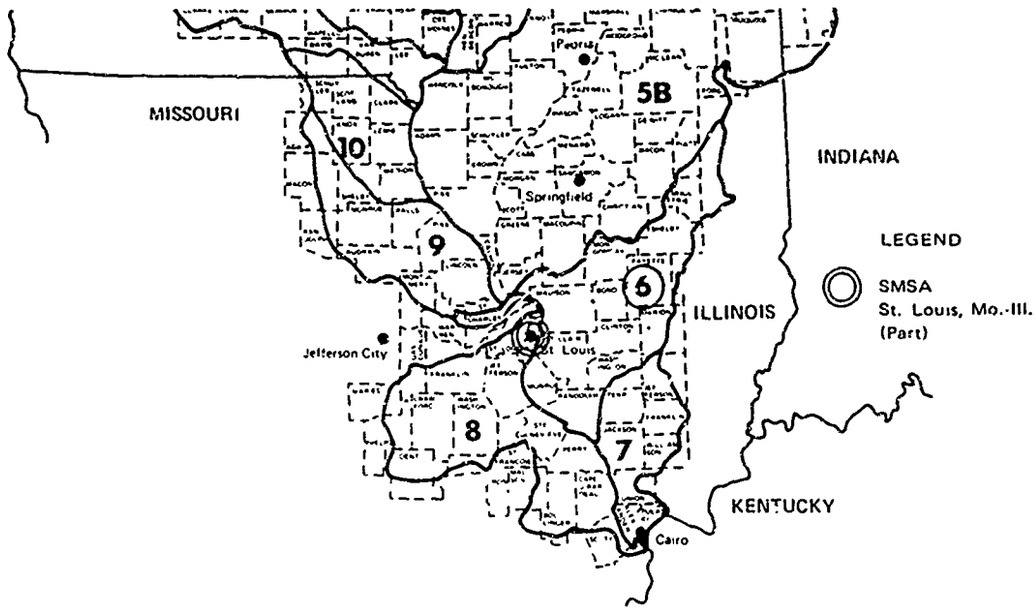

Figure P-12. Upper Mississippi River Basin Plan Area No. 6.

Table P-26

Economic Profile of Plan Area 6, Kaskaskia River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	714	3.7	642	3.7	72	3.6	1,358	2.9	1,902	79
1980	893	3.4	844	3.4	49	3.4	2,985	2.8	3,343	81
2000	1,123	3.2	1,086	3.2	37	3.4	6,409	2.8	5,707	87
2020	1,460	3.0	1,427	3.0	33	3.6	13,373	2.7	9,160	89

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	221	2.9	131	2.8	90	3.2	66	24
1980	279	2.8	191	2.8	88	2.9	66	22
2000	354	2.7	263	2.6	91	2.8	72	19
2020	462	2.6	365	2.6	97	2.7	81	16

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	9	5	6	5	17	5	47
1980	9	6	4	5	19	6	49
2000	9	8	3	5	21	8	54

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cem.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	1.3	90	104	--	220	59	592
1980	284	328	207	–	462	140	1,421

[a] Noncommodity group includes the following SIC categories: 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories 01–09 Agriculture; 10–14 Mining; 19 Ordnance, 20 Food; 21 Tobacco, 22 Textiles, 23 Apparel, 24 Lumber, 25 Furniture, 26 Pulp and Paper; 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics, 31 Leather Products, 32 Stone, Clay, and Glass; 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment; 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

Table P-27

Economic Data by County for
Plan Area 7, Big Muddy River

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Alexander	Illinois	9,348	16,661	20,316	25,496	224
Franklin	Illinois	18,904	39,281	48,685	53,137	434
Jackson	Illinois	23,343	42,151	38,124	37,920	603
Jefferson	Illinois	15,566	32,315	35,892	34,375	574
Perry	Illinois	9,643	19,184	21,684	23,438	443
Pulaski	Illinois		10,490	13,639	15,875	204
Union	Illinois	4,280	17,645	20,500	21,528	414
Williamson	Illinois	27,282	46,117	48,621	51,424	427
Total		106,366	223,244	247,461	263,193	3,323

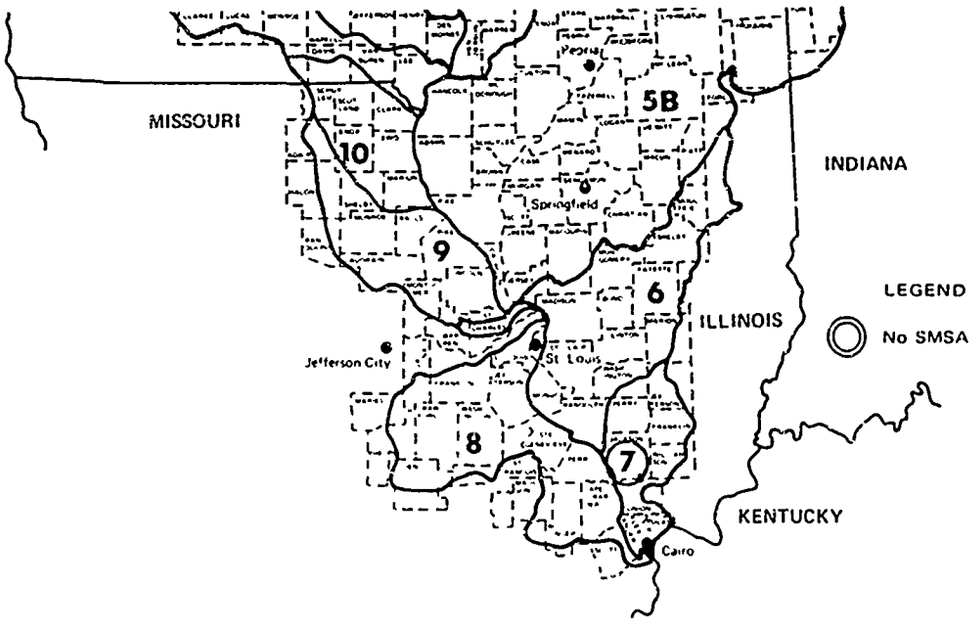

Figure P-13. Upper Mississippi River Basin Plan Area No. 7.

Table P-28

Economic Profile of Plan Area 7, Big Muddy River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	224	1.2	195	1.1	29	1.5	370	0.8	1,657	69
1980	268	1.0	243	1.0	25	1.7	807	0.8	3,016	73
2000	327	0.9	308	0.9	19	1.7	1,669	0.7	5,109	78
2020	424	0.9	407	0.9	17	1.8	3,430	0.7	8,080	79

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	66	0.9	44	0.9	22	0.8	10	12
1980	83	0.8	64	0.9	19	0.6	9	10
2000	106	0.8	88	0.9	18	0.6	9	9
2020	135	0.8	118	0.8	17	0.5	9	8

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 Chem.	29 Petrol Prod	32 Stone, Clay, Glass	33 Primary Metals	34, 35 Fabr. Met. & Nonelec. Mach.	Total
1960	1	1	-	[c]	[c]	[c]	2
1980	1	1	-	[c]	[c]	[c]	2
2000	1	1	-	[c]	[c]	[c]	2

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 Chem	291 Petrol Ref	324 Hyd Cemt	33 Primary Metals	34, 35 Fabr Met & Nonelec Mach.	Total
1960	15	9	-		2	3	29
1980	43	25	-		6	8	82

[a] Noncommodity group includes the following SIC categories 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade, 52–59 Retail Trade, 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel, 24 Lumber, 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics, 31 Leather Products, 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery, 36 Electrical Equipment, 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-29
Economic Data by County for Plan Area 8, Meramec River

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Bollinger	Missouri		9,167	11,019	12,698	618
Cape Girardeau	Missouri	29,822	42,020	38,397	37,775	576
Crawford	Missouri	656	12,647	11,615	12,693	760
Dent	Missouri	3,870	10,445	10,936	11,763	756
Franklin[1]	Missouri	20,846	44,566	36,046	32,868	932
Gasconade	Missouri	2,536	12,195	12,342	12,414	520
Iron	Missouri		8,041	9,458	10,440	554
Jefferson[1]	Missouri	16,503	66,373	38,007	32,023	667
Madison	Missouri	3,484	9,366	10,380	9,656	496
Maries	Missouri		7,282	7,423	8,638	526
Perry	Missouri	5,317	14,642	14,890	15,358	476
Phelps	Missouri	11,122	25,396	21,504	17,437	677
St. Charles[1]	Missouri	27,701	52,970	29,834	25,562	561
St. Francois	Missouri	13,352	33,516	35,276	35,950	457
St. Louis[1]	Missouri	649,814	703,532	406,349	274,230	497
St. Louis City[1]	Missouri	750,026	750,026	856,796	816,048	61
Ste Genevieve	Missouri	4,443	12,116	11,237	10,905	500
Scott	Missouri	16,541	32,748	32,842	30,377	418
Washington	Missouri	2,805	14,346	14,689	17,492	760
Total		1,558,648	1,864,398	1,609,040	1,425,527	10,812

[1] St Louis, Mo. Ill. SMSA (Missouri Part)

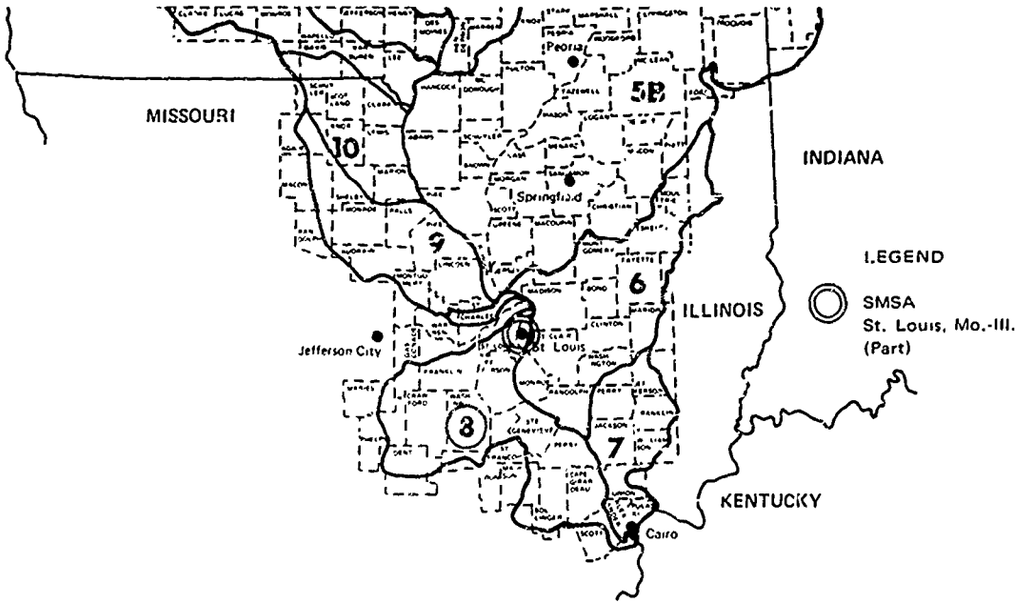

Figure P-14. Upper Mississippi River Basin Plan Area No. 8.

Table P-30

Economic Profile of Plan Area 8, Meramec River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	1,865	9.7	1,798	10.4	67	3.4	4,619	9.9	2,478	103
1980	2,568	9.8	2,529	10.2	39	2.7	11,014	10.3	4,289	104
2000	3,584	10.2	3,558	10.4	26	2.4	24,223	10.4	6,759	103
2020	4,841	10.0	4,816	10.2	25	2.7	50,768	10.2	10,488	102

	Employment, thousand							
Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	715	9.5	463	9.7	252	9.0	231	21
1980	1,004	10.1	717	10.4	287	9.5	267	20
2000	1,372	10.4	1,04	10.5	330	10.1	313	17
2020	1,855	10.6	1,472	10.5	383	10.6	369	14

	Employment for Selected Manufacturing Industries by SIC, thousand						
Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	26	16	(c)	8	6	35	91
1980	27	20	(c)	8	6	44	105
2000	27	27	(c)	8	7	58	127

	Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars						
Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	408	317	–	19	63	369	1,176
1980	1,211	1 122	–	43	135	1,295	3,806

[a] Noncommodity group includes the following SIC categories. 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities, 50 Wholesale Trade, 52–59 Retail Trade, 60–67 Finance, Insurance, and Real Estate, 70 89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories. 01–09 Agriculture, 10 14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel, 24 Lumber, 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics, 31 Leather Products, 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery, 36 Electrical Equipment, 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-31
Economic Data by County for Plan Area 9, Salt River

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Adair	Missouri	13,123	20,105	19,689	20,246	574
Audrain	Missouri	15,944	26,079	23,829	22,673	692
Lincoln	Missouri		14,783	13,478	14,395	629
Macon	Missouri	4,547	16,473	18,332	21,396	814
Monroe	Missouri		10,688	11,314	13,195	669
Montgomery	Missouri		11,097	11,555	12,442	533
Pike	Missouri	6,936	16,706	16,844	18,327	681
Ralls	Missouri	85	8,078	8,685	10,040	478
Randolph	Missouri	13,170	22,014	22,918	24,458	484
Shelby	Missouri		9,063	9,730	11,224	502
Warren	Missouri		8,750	7,666	7,734	428
Total		53,805	163,836	164,041	176,130	6,484

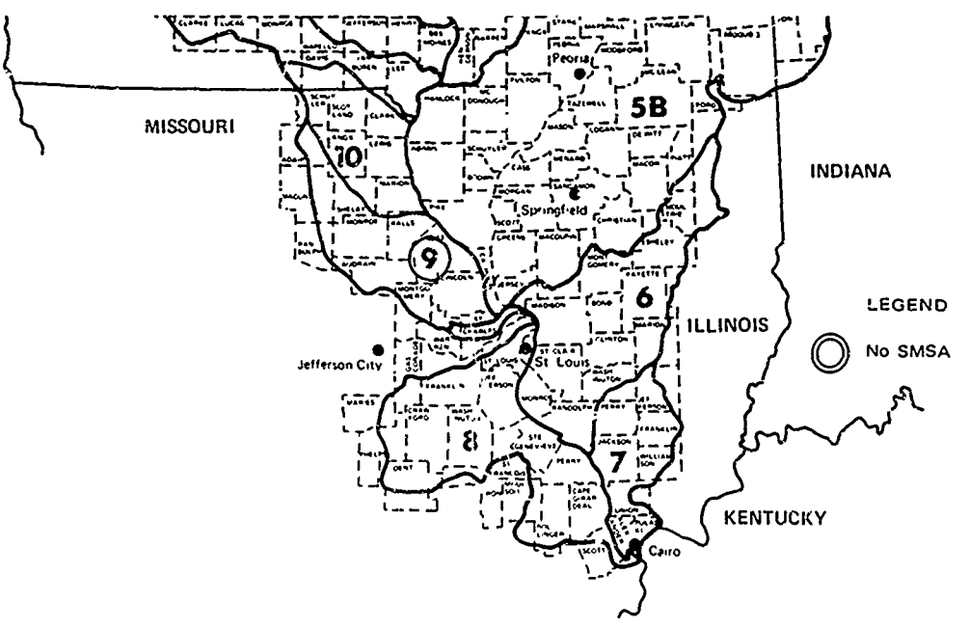

Figure P-15. Upper Mississippi River Basin Plan Area No. 9.

Table P-32

Economic Profile of Plan Area 9, Salt River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	164	0.8	114	0.7	50	2.5	258	0.6	1,572	65
1980	178	0.7	141	0.6	37	2.6	520	0.5	2,914	71
2000	227	0.6	194	0.6	33	3.0	1,063	0.5	4,675	71
2020	294	0.6	268	0.6	26	2.8	2,137	0.4	7,259	71

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	55	0.7	29	0.6	26	0.9	10	16
1980	64	0.6	42	0.6	22	0.7	9	13
2000	78	0.6	58	0.6	20	0.6	10	10
2020	102	0.6	82	0.6	20	0.6	12	8

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	1	[c]	–	3	[c]	2	6
1980	1	1	–	3	[c]	2	7
2000	1	1	–	3	[c]	2	7

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	9	7	–	7	2	12	37
1980	22	28	–	16	4	43	113

[a] Noncommodity group includes the following SIC categories: 15–17 Construction; 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories: 01–09 Agriculture; 10–14 Mining, 19 Ordnance; 20 Food; 21 Tobacco; 22 Textiles; 23 Apparel; 24 Lumber, 25 Furniture; 26 Pulp and Paper; 27 Printing and Publishing; 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics; 31 Leather Products; 32 Stone, Clay, and Glass; 33 Primary Metals; 34 Fabricated Metals, 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-33

Economic Data by County for
Plan Area 10, Fox, Wyaconda, and Fabius Rivers

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1954 Total	1940 Total	
Clark	Missouri		8,725	9,003	10,166	509
Knox	Missouri		6,558	7,617	9,878	512
Lewis	Missouri	2,562	10,994	10,733	11,490	505
Marion	Missouri	22,276	29,522	29,765	31,576	440
Scotland	Missouri		5,052	5,780	6,627	306
Scotland	Missouri		6,484	7,332	8,557	441
Total		25,438	67,325	70,219	77,294	2,713

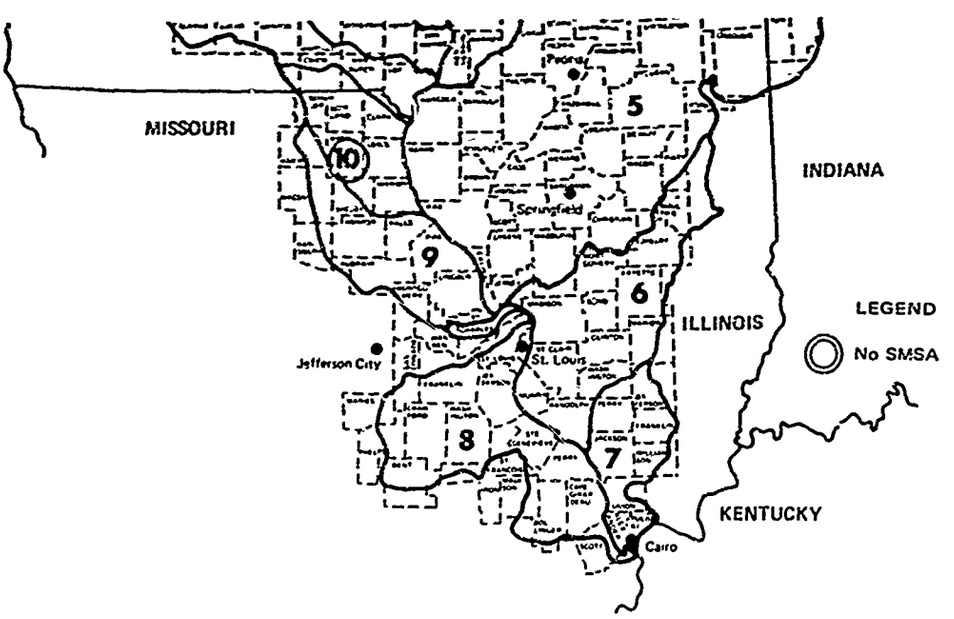

Figure P-16. Upper Mississippi River Basin Plan Area No. 10.

Table P-34

Economic Profile of Plan Area 10, Fox, Wyaconda, and Fabius Rivers

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	67	0.3	46	0.2	21	1.1	105	0.2	1,560	65
1980	75	0.3	57	0.2	18	1.2	219	0.2	2,924	71
2000	95	0.3	79	0.2	16	1.4	451	0.2	4,742	72
2020	124	0.3	112	0.2	13	1.4	918	0.2	7,379	72

	Employment, thousand							
Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	18	0.2	10	0.2	8	0.3	2	6
1980	22	0.2	14	0.2	8	0.3	3	5
2000	28	0.2	19	0.2	9	0.3	5	4
2020	36	0.2	26	0.2	10	0.3	7	3

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	(c)	–	–	(c)	(c)	(c)	1
1980	(c)	–	–	(c)	(c)	(c)	1
2000	(c)	–	–	(c)	(c)	(c)	1

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cem.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	3	–	–	–	2	4	9
1980	8	–	–	–	3	8	19

[a] Noncommodity group includes the following SIC categories: 15–17 Construction; 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate; 70–89 Services; and 91–93 Government.

[b] Commodity group includes SIC categories: 01–09 Agriculture; 10–14 Mining; 19 Ordnance; 20 Food; 21 Tobacco; 22 Textiles, 23 Apparel; 24 Lumber; 25 Furniture; 26 Pulp and Paper; 27 Printing and Publishing; 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics; 31 Leather Products; 32 Stone, Clay, and Glass; 33 Primary Metals; 34 Fabricated Metals, 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment; 38 Instruments; and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-35
Economic Data by County for Plan Area 11, Des Moines River

County Name	State Name	Population 1960 Urban	Population 1960 Total	Population 1950 Total	Population 1940 Total	Land Area (sq. miles)
Jackson	Minnesota	3,370	15,501	16,306	16,805	696
Murray	Minnesota		14,743	14,801	15,060	708
Nobles	Minnesota	9,015	23,365	22,435	21,215	712
Boone	Iowa	12,468	28,037	28,439	29,782	573
Buena Vista	Iowa	7,728	21,189	21,113	19,838	573
Calhoun	Iowa		15,923	16,925	17,584	572
Carroll	Iowa	7,682	23,431	23,065	22,770	574
Clarke	Iowa	3,350	8,222	9,389	10,233	429
Dallas	Iowa	6,442	24,123	23,661	24,649	597
Davis	Iowa	2,771	9,199	9,959	11,136	509
Emmet	Iowa	7,977	14,871	14,102	13,406	395
Greene	Iowa	4,570	14,379	15,546	16,599	569
Guthrie	Iowa		13,607	15,197	17,210	596
Hamilton	Iowa	8,520	20,032	19,660	19,922	577
Humboldt	Iowa	4,031	13,156	13,117	13,459	435
Kossuth	Iowa	5,702	25,314	26,241	26,630	979
Lee	Iowa	31,563	44,207	43,102	41,074	522
Lucas	Iowa	5,042	10,923	12,069	14,570	433
Madison	Iowa	3,639	12,295	13,131	14,525	565
Marion	Iowa	13,015	25,886	25,930	27,019	568
Monroe	Iowa	4,582	10,463	11,514	14,553	435
Palo Alto	Iowa	2,887	14,736	15,891	16,170	561
Pocahontas	Iowa		14,234	15,496	16,256	580
Polk[3]	Iowa	244,079	266,315	226,010	195,835	594

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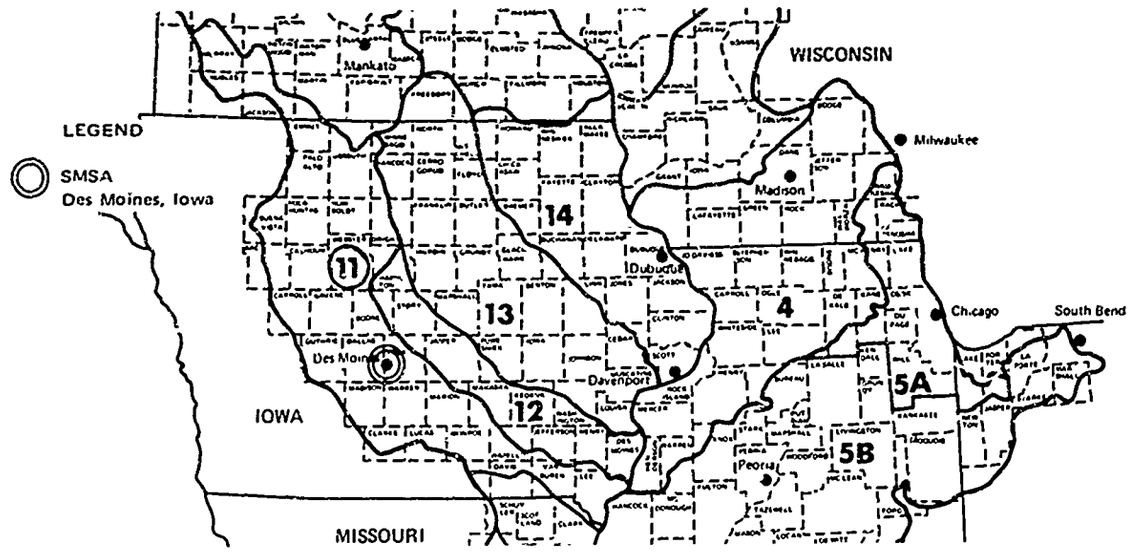

Figure P-17. Upper Mississippi River Basin Plan Area No. 11.

Table P-35 (con.)

County Name	State Name	Population 1960 Urban	Population 1960 Total	Population 1950 Total	Population 1940 Total	Land Area (sq miles)
Sac	Iowa	3,354	17,007	17,518	17,639	578
Van Buren	Iowa		9,778	11,007	12,053	487
Wapello	Iowa	33,871	46,126	47,397	44,280	437
Warren	Iowa	7,062	20,829	17,758	17,695	572
Webster	Iowa	28,399	47,810	44,241	41,521	718
Wright	Iowa	10,119	19,447	19,652	20,033	577
Total		472,188	845,148	810,650	729,536	17,123

[a] Des Moines, Iowa SMSA

Table P-36

Economic Profile of Plan Area 11, Des Moines River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1969 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	845	4.4	653	3.8	192	9.7	1,786	3.8	2,114	88
1980	1,112	4.3	971	3.9	141	9.8	4,130	3.8	3,713	90
2000	1,472	4.2	1,363	4.0	109	10.6	9,212	4.0	6,258	95
2020	1,946	4.0	1,850	3.9	96	10.4	19,026	3.8	9,777	95

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	303	4.0	196	4.1	107	3.8	47	60
1980	404	4.1	301	4.4	103	3.4	51	52
2000	530	4.0	432	4.3	98	3.0	57	41
2020	699	4.0	601	4.3	98	2.7	64	34

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	12	1	(c)	4	1	12	30
1980	12	1	(c)	4	1	14	32
2000	12	1	(c)	5	1	16	35

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cem.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	136	23	–	11	12	122	304
1980	299	65	–	36	20	251	671

[a] Noncommodity group includes the following SIC categories. 15 - 17 Construction, 40 - 49 Transportation, Communications, and Public Utilities, 50 Wholesale Trade, 52–59 Retail Trade, 60 - 67 Finance, Insurance, and Real Estate, 70 - 89 Services, and 91 - 93 Government.

[b] Commodity group includes SIC categories. 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel, 24 Lumber, 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics, 31 Leather Products, 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery, 36 Electrical Equipment, 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-37

Economic Data by County for:

Plan Area 12, Skunk River

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Des Moines	Iowa	34,990	44,605	42,056	36,804	409
Henry	Iowa	7,339	18,187	18,708	17,994	440
Jasper	Iowa	15,381	35,282	32,305	31,496	736
Jefferson	Iowa	8,054	15,818	15,686	15,762	436
Keokuk	Iowa		15,492	16,797	18,406	579
Mahaska	Iowa	11,053	23 602	24,672	26,485	572
Story	Iowa	31,230	49,327	44,294	33,434	568
Washington	Iowa	6,037	19,406	19,557	20,055	568
Total		114,084	221,719	214,085	200,436	4,308

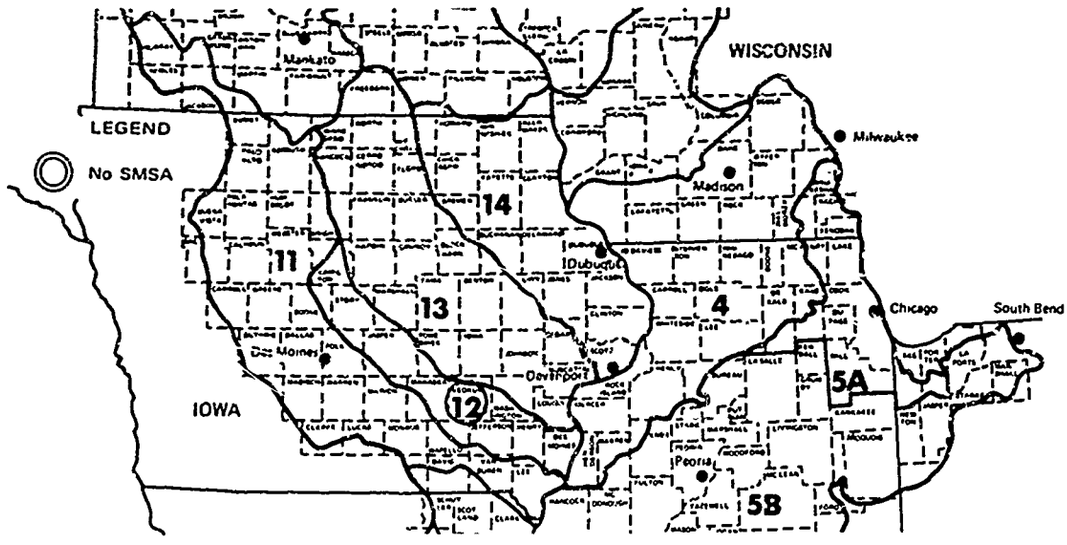

Figure P-18. Upper Mississippi River Basin Plan Area No. 12.

Table P-38

Economic Profile of Plan Area 12, Skunk River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	222	1.1	169	1.0	53	2.7	427	0.9	1,925	80
1980	286	1.1	250	1.0	36	2.5	955	0.9	3,338	81
2000	392	1.1	364	1.1	28	2.6	2,040	0.9	5,334	81
2020	545	1.1	523	1.1	22	2.4	4,586	0.9	8,418	82

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	83	1.1	43	0.9	40	1.4	23	17
1980	117	1.2	68	1.0	49	1.6	35	14
2000	159	1.2	100	1.0	59	1.8	47	12
2020	218	1.2	146	1.0	72	2.0	62	10

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	2	[c]	[c]	[c]	1	3	6
1980	2	[c]	[c]	[c]	1	3	6
2000	2	[c]	[c]	[c]	1	3	6

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	19	5	–	–	4	34	62
1980	43	12	–	–	7	63	125

[a] Noncommodity group includes the following SIC categories. 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories. 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel; 24 Lumber; 25 Furniture; 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics; 31 Leather Products; 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-39
Economic Data by County for
Plan Area 13, Iowa and Cedar Rivers

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Freeborn	Minnesota	17,108	37,891	34,517	31,780	702
Mower	Minnesota	27,908	48,498	42,277	36,113	703
Benton	Iowa	7,704	23,422	22,656	22,879	718
Black Hawk[a]	Iowa	102,827	122,462	100,448	79,945	567
Butler	Iowa		17,467	17,394	17,936	582
Cedar	Iowa	2,852	17,791	18,970	16,884	585
Cerro Gordo	Iowa	36,800	49,894	46,053	43,845	576
Floyd	Iowa	9,964	21,102	21,505	20,169	503
Franklin	Iowa	4,501	15,472	16,268	16,379	586
Grundy	Iowa		14,132	13,722	13,518	501
Hancock	Iowa		14,604	15,077	15,402	570
Hardin	Iowa	8,790	22,533	22,218	22,530	574
Iowa	Iowa		16,396	15,835	17,016	584
Johnson	Iowa	33,443	53,663	45,756	33,191	617
Linn[b]	Iowa	107,711	136,699	104,274	89,142	713
Louisa	Iowa		10,290	11,101	11,384	403
Marshall	Iowa	22,521	37,984	35,611	35,406	574
Mitchell	Iowa	3,753	14,043	13,945	14,121	467
Muscatine	Iowa	20,997	33,840	32,148	31,296	439
Poweshiek	Iowa	7,367	19,300	19,344	18,758	589
Tama	Iowa	5,775	21,413	21,688	22,428	720
Winnebago	Iowa	2,930	13,099	13,450	13,972	401
Worth	Iowa		10,259	11,068	11,449	400
Total		422,961	772,474	693,265	635,594	13,074

[a] Waterloo, Iowa SMSA
[b] Cedar Rapids, Iowa SMSA

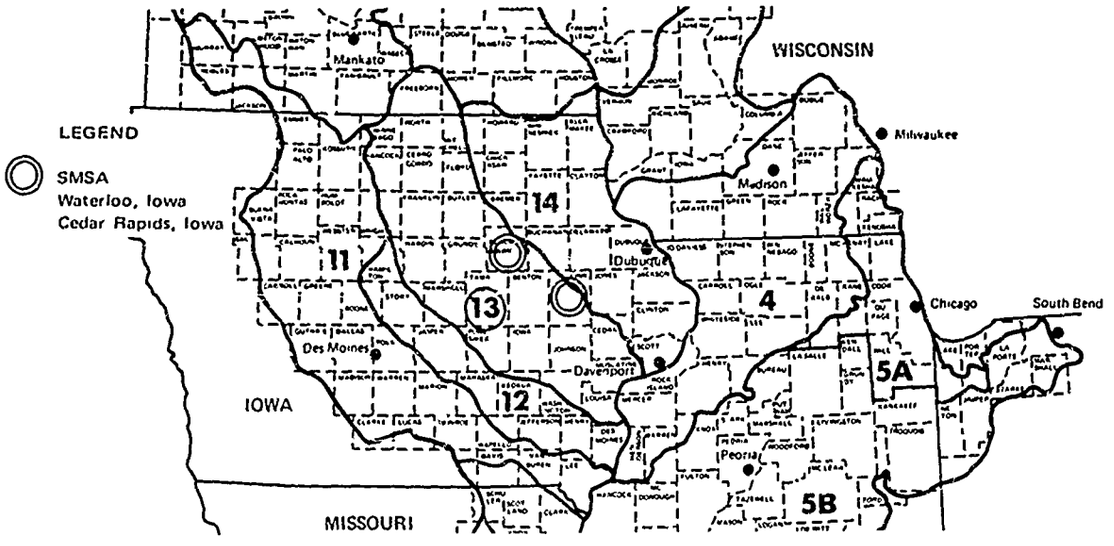

Figure P-19. Upper Mississippi River Basin Plan Area No. 13.

Table P-40

Economic Profile of Plan Area 13, Iowa and Cedar Rivers

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	773	4.0	603	3.5	170	8.6	1,647	3.5	2,133	89
1980	1,048	4.0	916	3.7	132	9.1	3,824	3.6	3,649	89
2000	1,407	4.0	1,313	3.8	94	8.6	8,239	3.5	5,858	89
2020	1,959	4.1	1,878	4.0	81	8.8	18,002	3.6	9,168	89

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	272	3.6	158	3.3	114	4.1	58	56
1980	359	3.6	244	3.5	115	3.8	66	49
2000	478	3.6	364	3.7	114	3.5	75	39
2020	644	3.7	525	3.8	119	3.3	87	32

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	17	2	[c]	2	1	21	43
1980	17	2	[c]	3	1	25	48
2000	17	2	[c]	3	1	27	50

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	218	38	–	28	6	241	531
1980	464	113	–	90	11	495	1,173

[a] Noncommodity group includes the following SIC categories. 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade, 52–59 Retail Trade, 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories. 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel; 24 Lumber, 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics, 31 Leather Products, 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery; 36 Electrical Equipment, 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-41

Economic Data by County for Plan Area 14, Turkey, Maquoketa, Wapsipinicon, and Upper Iowa Rivers

County Name	State Name	Population				Land Area (Sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Allamakee	Iowa	3,639	16,982	16,351	17,184	639
Bremer	Iowa	6,357	21,108	18,884	17,932	439
Buchanan	Iowa	5,498	22,293	21,927	20,991	569
Chickasaw	Iowa	3,456	15,034	15,228	15,227	505
Clayton	Iowa	0	21,962	22,522	24,334	778
Clinton	Iowa	36,813	55,060	49,664	44,722	695
Delaware	Iowa	4,482	18,483	17,734	18,487	573
Dubuque[a]	Iowa	60,103	80,048	71,337	63,768	608
Fayette	Iowa	10,833	28,581	28,294	29,151	728
Howard	Iowa	3,809	12,734	13,105	13,531	471
Jackson	Iowa	5,909	20,754	18,622	19,181	644
Jones	Iowa	7,806	20,693	19,401	19,950	585
Scott[b]	Iowa	101,018	119,067	100,698	84,748	453
Winneshiek	Iowa	6,435	21,651	21,639	22,263	688
Total		256,158	473,450	435,406	411,469	8,375

[a] Dubuque, Iowa SMSA
[b] Davenport, Rock Island, Moline, Iowa-Ill. SMSA (Iowa Part)

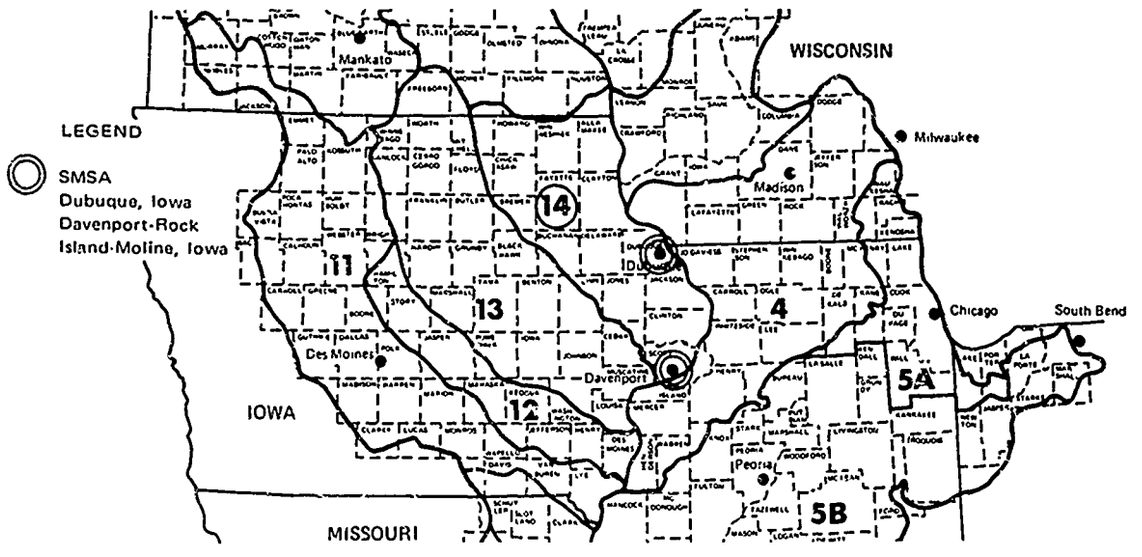

Figure P-20. Upper Mississippi River Basin Plan Area No. 14.

Table P-42

Economic Profile of Plan Area 14, Turkey, Maquoketa, Wapsipinicon, and Upper Iowa Rivers

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	474	2.5	357	2.1	117	5.9	950	2.0	2,006	83
1980	619	2.4	522	2.1	97	6.7	2,240	2.1	3,622	88
2000	856	2.4	781	2.3	75	6.9	5,274	2.3	6,158	94
2020	1,190	2.5	1,126	2.4	64	6.9	11,650	2.3	9,832	96

	Employment, thousand							
Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	173	2.3	91	1.9	82	2.9	43	39
1980	225	2.3	144	2.1	81	2.7	48	33
2000	296	2.2	219	2.2	77	2.4	51	26
2020	408	2.3	333	2.4	75	2.1	55	20

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec Mach.	Total
1960	21	1	–	(c)	4	7	33
1980	22	1	–	(c)	5	7	35
2000	22	1	–	1	5	7	36

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	215	33	–	–	52	83	383
1980	519	73	–	–	120	147	859

[a] Noncommodity group includes the following SIC categories: 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade; 52–59 Retail Trade; 60–67 Finance, Insurance, and Real Estate; 70–89 Services; and 91–93 Government.

[b] Commodity group includes SIC categories: 01–09 Agriculture; 10–14 Mining, 19 Ordnance, 20 Food; 21 Tobacco; 22 Textiles; 23 Apparel; 24 Lumber; 25 Furniture; 26 Pulp and Paper; 27 Printing and Publishing; 28 Chemicals; 29 Petroleum Products; 30 Rubber and Plastics; 31 Leather Products; 32 Stone, Clay, and Glass; 33 Primary Metals; 34 Fabricated Metals; 35 Nonelectrical Machinery; 36 Electrical Equipment; 37 Transportation Equipment; 38 Instruments; and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-43
Economic Data by County for
Plan Area 15, Cannon, Zumbro, and Root Rivers

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Dodge	Minnesota		13,259	12,024	12,931	435
Fillmore	Minnesota	2,628	23,758	24,465	25,830	859
Goodhue	Minnesota	10,528	33,935	32,118	31,564	758
Houston	Minnesota	5,187	16,588	14,435	14,735	565
Olmsted	Minnesota	40,663	65,532	48,228	42,658	655
Rice	Minnesota	25,633	38,982	36,235	32,160	495
Steele	Minnesota	13,408	25,029	21,155	19,749	425
Wabasha	Minnesota	5,994	17,007	16,878	17,653	521
Winona	Minnesota	24,895	40,937	39,841	37,795	623
Total		128,937	274,143	245,979	235,075	5,336

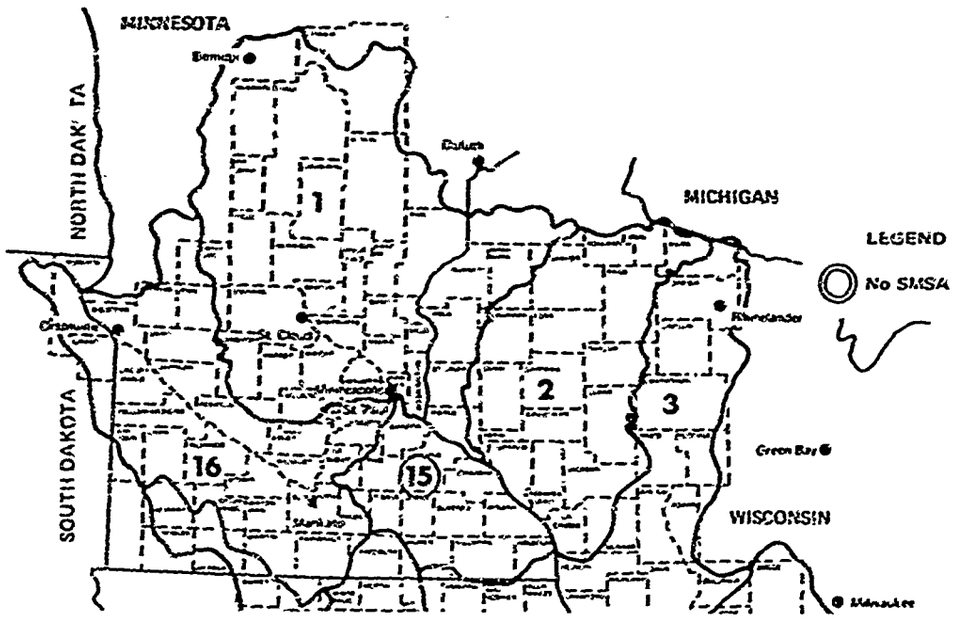

Figure P-21. Upper Mississippi River Basin Plan Area No. 15.

Table P-44

Economic Profile of Plan Area 15, Cannon, Zumbro, and Root Rivers

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	274	1.4	203	1.2	71	3.6	491	1.1	1,793	74
1980	357	1.4	296	1.2	61	4.2	1,204	1.1	3,374	82
2000	455	1.3	408	1.2	47	4.3	2,696	1.2	5,930	90
2020	600	1.2	562	1.2	38	4.1	5,893	1.2	9,817	95

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	99	1.3	62	1.3	37	1.3	15	22
1980	132	1.3	94	1.4	38	1.3	19	19
2000	177	1.3	137	1.4	40	1.2	24	16
2020	223	1.3	181	1.3	42	1.2	31	11

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	4	[c]	–	1	[c]	4	9
1980	4	[c]	–	1	[c]	7	12
2000	4	[c]	–	1	[c]	11	16

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cem.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	45	5	–	–	1	43	94
1980	112	17	–	–	2	141	272

[a] Noncommodity group includes the following SIC categories: 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities; 50 Wholesale Trade, 52–59 Retail Trade; 60–67 Finance, Insurance and Real Estate; 70–89 Services; and 91–93 Government.

[b] Commodity group includes SIC categories: 01–09 Agriculture; 10–14 Mining; 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel; 24 Lumber; 25 Furniture; 26 Pulp and Paper; 27 Printing and Publishing; 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics; 31 Leather Products; 32 Stone, Clay, and Glass; 33 Primary Metals; 34 Fabricated Metals, 35 Nonelectric Machinery; 36 Electrical Equipment; 37 Transportation Equipment; 38 Instruments; and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-45
Economic Data by County for Plan Area 16, Minnesota River

County Name	State Name	Population				Land Area (sq. miles)
		1960 Urban	1960 Total	1950 Total	1940 Total	
Big Stone	Minnesota	2,674	8,954	9,607	10,447	510
Blue Earth	Minnesota	23,797	44,385	38,327	36,203	740
Brown	Minnesota	17,307	27,676	25,895	28,544	613
Chippewa	Minnesota	6,256	16,320	16,739	16,927	582
Cottonwood	Minnesota	3,691	16,166	15,763	16,143	640
Douglas	Minnesota	6,713	21,313	21,304	20,369	637
Faribault	Minnesota	7,097	23,685	23,879	23,941	713
Lac Qui Parle	Minnesota		13,330	14,545	15,509	773
LeSueur	Minnesota	4,229	19,906	19,068	19,227	441
Lincoln	Minnesota		9,651	10,150	10,790	540
Lyon	Minnesota	9,543	22,655	22,253	21,569	713
Martin	Minnesota	9,745	26,986	25,655	24,656	707
Nicollet	Minnesota	14,411	23,196	20,929	18,282	459
Pope	Minnesota	2,631	11,914	12,862	13,544	681
Redwood	Minnesota	4,285	21,718	22,127	22,290	874
Renville	Minnesota		23,249	23,954	24,625	980
Sibley	Minnesota		16,228	15,816	16,625	581
Stevens	Minnesota	4,199	11,262	11,106	11,039	570
Swift	Minnesota	3,678	14,936	15,837	15,469	747
Waseca	Minnesota	5,898	16,041	14,957	15,186	415
Watonwan	Minnesota	4,174	14,460	13,881	13,902	433
Yellow Medicine	Minnesota	2,165	15,523	16,279	16,917	758
Grant	S. Dakota	3,500	9,913	10,233	10,552	684
Roberts	S. Dakota	3,218	12,190	14,929	15,887	1,111
Total		139,211	442,657	436,115	435,650	15,902

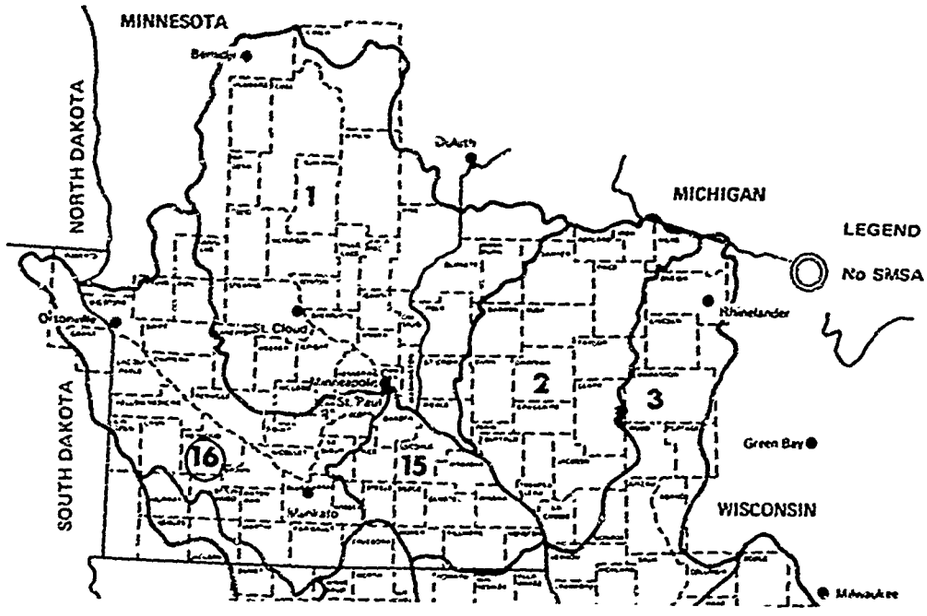

Figure P-22. Upper Mississippi River Basin Plan Area No. 16.

Table P-46

Economic Profile of Plan Area 16, Minnesota River

	Population, thousand						Personal Income			
	Total		Nonfarm		Farm		Total Income		Per Capita Income	
Year	Number	Percent of Basin	Number	Percent of Basin	Number	Percent of Basin	Million 1960 Dollars	Percent of Basin	Dollars	Ratio to Basin
1960	443	2.3	274	1.6	169	8.5	716	1.5	1,617	67
1980	502	1.9	374	1.5	128	8.9	1,668	1.6	3,323	81
2000	593	1.7	487	1.4	106	9.7	3,524	1.5	5,948	90
2020	760	1.6	664	1.4	96	10.4	7,525	1.5	9,905	96

Employment, thousand

Year	Total	Percent of Basin	Noncommodity Producing[a]	Percent of Basin	Commodity Producing[b]	Percent of Basin	Manufacturing Commodities	Nonmanufacturing Commodities
1960	143	1.9	74	1.6	69	2.5	13	56
1980	163	1.6	98	1.4	65	2.2	17	48
2000	196	1.5	138	1.4	58	1.8	20	38
2020	244	1.4	188	1.3	56	1.6	25	31

Employment for Selected Manufacturing Industries by SIC, thousand

Year	20 – Food	28 – Chem.	29 – Petrol. Prod.	32 – Stone, Clay, Glass	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	7	[c]	–	1	[c]	1	9
1980	7	[c]	–	1	[c]	2	10
2000	7	[c]	–	1	[c]	3	11

Output (Value Added) for Selected Manufacturing Industries by SIC, million 1960 dollars

Year	20 – Food	28 – Chem.	291 – Petrol. Ref.	324 – Hyd. Cemt.	33 – Primary Metals	34, 35 – Fabr. Met. & Nonelec. Mach.	Total
1960	81	1	–	–	1	15	98
1980	203	9	–	–	2	42	256

[a] Noncommodity group includes the following SIC categories. 15–17 Construction, 40–49 Transportation, Communications, and Public Utilities, 50 Wholesale Trade, 52–59 Retail Trade, 60–67 Finance, Insurance, and Real Estate, 70–89 Services, and 91–93 Government.

[b] Commodity group includes SIC categories. 01–09 Agriculture, 10–14 Mining, 19 Ordnance, 20 Food, 21 Tobacco, 22 Textiles, 23 Apparel, 24 Lumber, 25 Furniture, 26 Pulp and Paper, 27 Printing and Publishing, 28 Chemicals, 29 Petroleum Products, 30 Rubber and Plastics, 31 Leather Products, 32 Stone, Clay, and Glass, 33 Primary Metals, 34 Fabricated Metals, 35 Nonelectrical Machinery, 36 Electrical Equipment, 37 Transportation Equipment, 38 Instruments, and 39 Miscellaneous Manufacturing and Other Manufacturing.

[c] Less than 500 employees.

Table P-47

Indexes of Change for Selected Economic and Demographic Factors by Plan Areas[a]

Year	Plan Areas																	Total Basin
	1	2	3	4	5A	5B	6	7	8	9	10	11	12	13	14	15	16	
Population:																		
1960	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1980	149	123	134	134	138	128	125	120	138	109	112	132	129	136	131	130	113	135
2000	199	159	179	187	188	174	157	146	192	138	142	174	177	182	181	166	134	183
2020	273	204	237	273	257	243	204	189	260	179	185	230	245	253	251	219	172	250
Employment:																		
1960	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1980	139	130	133	134	128	129	126	126	140	116	122	133	141	132	130	133	114	131
2000	189	167	173	180	170	174	160	161	192	142	156	175	192	176	171	179	137	175
2020	250	208	224	246	225	239	209	204	259	185	200	231	263	237	236	225	171	233
Income:																		
1960	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1980	249	230	243	239	222	243	220	218	238	202	209	231	224	232	236	245	233	231
2000	564	516	553	555	460	553	472	451	481	412	430	516	478	500	555	549	492	499
2020	1249	1100	1193	1237	961	1213	985	927	1099	828	874	1065	1074	1093	1226	1200	1051	1064
Selected Manufacturing Employment:[b]																		
1960	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1980	125	100	143	100	105	109	104	100	115	117	100	107	130	112	106	133	111	109
2000	143	113	179	113	109	133	115	109	140	117	100	117	166	116	109	178	122	119
Selected Manufacturing Output:[b]																		
1960	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1980	284	303	444	221	229	222	240	283	324	305	211	221	202	221	224	289	261	242

[a] Indexes are based on projections contained in Tables P-13 through P-46.

[b] Includes the following manufacturing industries: Food (SIC 20); Chemicals (SIC 28); Petroleum Products (SIC 29); Stone, Clay and Glass (SIC 32); Primary Metals (SIC 33); and Fabricated Metals and Nonelectric Machinery (SIC 34 and 35).

Section 2

GENERAL ECONOMIC AND DEMOGRAPHIC CHANGES – THE NATION, THE MULTISTATE REGION, THE BASIN, AND ECONOMIC SUBREGIONS*

This section provides economic and demographic information for the Nation, Multistate Region, Basin, and Economic Subregions which is a required input to water and related land resources planning. The National Planning Association (NPA), Washington, D.C., under contract with the Corps of Engineers, North Central Division, collected the data and prepared the projections of economic and demographic activity. The NPA report is available in its entirety in Draft No. 2 of this appendix.

The information includes past and projected changes in the level and composition of population, labor force, employment by industry group, personal income, and related measures. The 1950–60 decade is the primary reference period for the analysis of historical changes, although account was taken of earlier and later trends as well. The projections are presented for 1980, 2000, and 2020 for the Nation, the six state region in which the Upper Mississippi River Basin is located (this includes Wisconsin, Minnesota, Iowa, Missouri, Indiana, and Illinois), the Upper Mississippi River Basin area and subregions within the Basin as defined by economic criteria.

In addition to the usual economic assumptions that a major nuclear conflict will not occur during this 60-year projection interval and that government and private policies will be successful in avoiding prolonged levels of high unemployment and inflation in the Nation, it has also been assumed that the quantity and quality of available water will not be a factor in limiting economic and population growth in the Basin region. The use of these projections for overall water planning purposes is to assist in the determination of the expected quantity and quality of water needs which will have to be met with a wise use of existing water resources as well as an expansion in water capacity where and when it is required. Thus, the projections show the changes which could occur if adequate water is provided, they do not indicate, however, whether further changes would occur if a still greater water supply is made available.

The analytical approach followed in this study requires an understanding of prospective trends for the Nation and multistate area – that is, the general environment within which the business prospects will be determined. It also requires a more detailed knowledge of the unique characteristics of the Basin region which was obtained from both secondary data sources and consultation with locally knowledgeable individuals.

The projection procedures followed are essentially an adaptation of the well-known export-base theory. That is, for each of the separate economic subregions, employment engaged in the production of goods and services to be sold outside the region is projected as a first approximation; this employment plus other unique local factors generate income which is spent on local goods and services that generate further employment and income. Natural increases in the population and labor force are compared with the first approximation employment projections to determine whether an excess of job opportunities is likely to induce migration into the area or a shortage of jobs is likely to induce emigration. In arriving at the final projections the interactions among population, employment, and income were evaluated in the context of such further characteristics as labor participation, the age, sex, race, and industrial characteristics of the work force; the prospective productivity changes for industry, and the shopping behavior of households.†

The main highlights of the study are summarized in *Table P-48* and in the following paragraphs.

Measured by population, labor force, employment, or personal income, the Basin is expected to continue to grow at a more rapid pace that its multistate area, but less than the national pace.

Between 1960 and the turn of the century, population in the Basin area is projected to grow at a decennial rate of about 17 percent, approaching 40 million by the year 2000 compared to 21 million in 1960. The Basin population is currently over 70 percent of the multistate population, and is expected to approach 80 percent by the year 2000.

Within the Basin area, the largest economic subregions are expected to grow at the most rapid rate. The Milwaukee subregion is projected at the highest rate of growth followed by Minneapolis-St. Paul, and Chicago. In 1960, these three subregions accounted for 58 percent of the Basin area population and are expected to pass 60 percent by the year 2000. The smallest subregions – Northeast Minnesota, Northwest Minnesota, and Southwest Minnesota – are projected to continue to lag behind the others in their rate of population growth.

Total personal income in the Basin is projected to more than triple (in constant prices) between 1960–90, and to triple again between 1990 and 2020.

*The analyses of subregions contained in this section of the summary report are based on detailed data reported in Chapter IV, Part II of Draft No. 2, Appendix P, June 1968.

†A complete discussion of projection methodology is included in Draft No. 2 of this appendix.

Table P-48

Summary of Population, Employment and Income, United States, Multistate Region, Upper Mississippi River Basin Economic Subregions — 1950–2020

			1950	1960	1970	1980	1990	2000	2010	2020
Population (thousands):										
Nation			151,241	179,986	206,477	241,288	283,864	331,013	390,927	460,576
Multistate			25,717	29,209	32,919	37,665	42,927	48,880	57,041	66,223
Total Basin			18,189	21,042	24,242	28,682	33,715	38,785	45,354	53,003
Economic Subregions:										
1	A	NE Minnesota	133.1	135.5	119.5	127.9	149.3	173.5	200.9	233.8
2	B	NW Minnesota	119.1	111.9	99.3	99.2	101.6	104.2	108.8	113.0
3	C	SW Minnesota	164.9	162.6	147.8	153.0	166.8	174.1	191.7	208.5
4	I	Minneapolis-St. Paul	2,026.7	2,439.1	2,972.7	3,646.5	4,230.4	4,800.7	5,584.6	6,587.8
5	II	Eau Claire	802.7	820.3	936.2	1,051.6	1,247.8	1,392.4	1,601.4	1,818.5
6	III	Des Moines-Ft. Dodge	1,335.5	1,389.3	1,594.3	1,840.0	2,150.9	2,448.4	2,851.8	3,272.1
7	IV	Davenport–Rock Island-Moline	1,301.5	1,432.0	1,573.4	1,844.3	2,193.1	2,552.1	3,061.6	3,669.3
8	V	Milwaukee	1,675.6	2,095.8	2,580.1	3,161.6	3,788.8	4,384.3	5,218.1	6,068.3
9	VIII	Chicago	6,288.2	7,656.3	8,774.0	10,467.3	12,370.1	14,289.5	16,722.5	19,600.6
10	VII	Peoria	1,334.3	1,470.3	1,616.1	1,937.0	2,251.2	2,621.0	3,079.1	3,645.4
11	VI	St. Louis	3,002.0	3,328.6	3,828.7	4,353.8	5,064.8	5,844.6	6,733.7	7,784.9
Employment (thousands):										
Nation			59,747	66,679	80,000	94,680	108,800	129,200	152,000	174,100
Multistate			10,920	11,544	13,091	15,069	16,964	19,574	22,635	25,470
Total Basin			7,304	8,305	9,468	10,950	12,649	14,559	16,925	19,375
Economic Subregions:										
1	A	NE Minnesota	42.7	34.9	38.7	43.2	48.6	55.1	62.1	70.5
2	B	NW Minnesota	34.8	35.5	36.0	35.3	34.6	36.6	37.5	38.3
3	C	SW Minnesota	52.5	51.1	51.8	53.6	55.8	60.0	65.0	69.2
4	I	Minneapolis-St. Paul	778.8	991.9	1,145.2	1,365.0	1,598.2	1,852.0	2,148.0	2,449.0
5	II	Eau Claire	277.1	273.0	314.6	358.2	409.8	464.2	533.9	604.1
6	III	Des Moines-Ft. Dodge	491.8	490.4	569.3	656.0	755.2	863.4	1,001.3	1,147.7
7	IV	Davenport-Rock Island-Moline	481.7	522.4	595.1	693.7	817.9	947.8	1,136.9	1,344.1
8	V	Milwaukee	719.0	877.5	1,048.8	1,220.5	1,413.6	1,618.8	1,890.7	2,159.8
9	VIII	Chicago	2,790.5	3,330.2	3,727.8	4,243.1	4,877.5	5,593.1	6,501.8	7,410.6
10	VII	Peoria	491.3	523.7	583.6	695.6	815.9	958.0	1,125.4	1,311.4
11	VI	St. Louis	1,143.5	1,174.6	1,356.5	1,585.2	1,822.0	2,110.2	2,422.2	2,770.5

Table P-48 (con.)

			1950	1960	1970	1980	1990	2000	2010	2020
Total Personal Income (million 1960 dollars):										
Nation			276,137	399,028	643,900	989,500	1,465,800	2,218,400	3,326,100	4,854,100
Multistate			49,898	67,535	105,077	166,950	244,336	330,184	490,210	704,282
Total Basin			37,631	51,153	79,304	117,479	171,971	253,255	373,986	540,200
Economic Subregions:										
1	A	NE Minnesota	134.8	193.9	274.4	398.8	590.1	897.0	1,333.0	1,939.4
2	B	NW Minnesota	129.4	152.9	208.3	270.3	354.2	497.4	682.6	901.3
3	C	SW Minnesota	235.8	247.8	327.9	447.4	618.4	883.3	1,276.7	1,773.9
4	I	Minneapolis-St. Paul	3,798.4	5,451.6	8,777.9	13,786.9	20,847.7	31,139.2	46,748.7	68,868.9
5	II	Eau Claire	1,079.2	1,399.4	2,205.4	3,319.9	4,997.6	7,491.0	11,189.0	16,071.9
6	III	Des Moines-Ft. Dodge	2,377.0	2,855.4	4,480.0	6,695.6	9,913.6	14,671.6	21,861.9	31,248.6
7	IV	Davenport-Rock Island-Moline	2,309.8	2,971.8	4,596.6	7,027.8	10,695.8	16,171.7	24,786.7	37,071.0
8	V	Milwaukee	3,666.3	5,248.2	8,362.4	12,573.1	18,649.2	27,448.8	41,348.2	59,382.0
9	VIII	Chicago	16,071.7	22,232.8	34,175.8	48,929.0	70,086.4	101,410.7	147,308.5	211,157.3
10	VII	Peoria	2,429.6	3,218.8	4,782.2	7,462.9	11,003.9	16,598.4	24,792.9	36,443.1
11	VI	St. Louis	5,399.3	7,109.7	11,113.4	16,567.0	24,213.8	36,045.7	52,657.5	75,342.3
Personal Income per Capita (1960 dollars):										
Nation			1,826	2,217	3,118	4,101	5,164	6,702	8,508	10,539
Multistate			1,940	2,312	3,192	4,167	5,226	6,775	8,594	10,635
Total Basin			2,054	2,431	3,271	4,096	5,101	6,530	8,246	10,192
Economic Subregions:										
1	A	NE Minnesota	976	1,431	2,296	3,118	3,952	5,170	6,635	8,295
2	B	NW Minnesota	1,086	1,366	2,098	2,725	3,486	4,774	6,274	7,976
3	C	SW Minnesota	1,430	1,524	2,219	2,924	3,707	5,074	6,660	8,508
4	I	Minneapolis-St. Paul	1,874	2,235	2,953	3,781	4,928	6,486	8,371	10,454
5	II	Eau Claire	1,344	1,706	2,356	3,157	4,005	5,380	6,987	8,838
6	III	Des Moines-Ft. Dodge	1,780	2,055	2,810	3,639	4,609	5,992	7,666	9,550
7	IV	Davenport-Rock Island-Moline	1,775	2,075	2,921	3,811	4,877	6,337	8,096	10,103
8	V	Milwaukee	2,188	2,504	3,241	3,977	4,922	6,261	7,924	9,784
9	VIII	Chicago	2,556	2,904	3,895	4,674	5,666	7,097	8,809	10,773
10	VII	Peoria	1,821	2,189	2,959	3,853	4,888	6,333	8,052	9,997
11	VI	St. Louis	1,798	2,157	2,903	3,805	4,781	6,167	7,820	9,678

Personal income grows much faster than population in the Basin area, indicating an appreciable increase in per capita income, which is projected to reach $6500 by the turn of the century. Compared with the 1960 level of $2400 this implies a per capita income growth of $1000 per decade. Per capita income in the Basin is currently above the national average, although it is projected to fall below the national level after 1980.

The rates of increase in constant dollar personal income per capita are expected to be much greater for the relatively low per capita income subregions (the Minnesotas and Eau Claire) than those which have already achieved a high level of average income, viz., the Chicago and Milwaukee subregions.

Employment in the Basin area is projected to pass 14.5 million jobs by the year 2000, implying an 80 percent increase over the 1960 level of 8.3 million. This implies that the Basin area will increase from 72 percent to 75 percent of multistate employment. About half of the employment increase will originate in services and education, with another two-fifths accounted for by the growth of trade, government, finance-insurance-real estate, and contract construction. Agriculture is projected to decrease both absolutely and as a percent of the Basin total employment during this period, while mining employment is projected to increase, although it declines in relative terms.

Manufacturing comprises a larger share of employment in the Basin area than it does in either the multistate region or the Nation. Although the relative importance of manufacturing in the Basin is projected to remain above the multistate and Nation, the differences are expected to become smaller.

Within the Basin, the Chicago, Milwaukee and St. Louis subregions are much more heavily dependent on manufacturing employment than the other subregions. In almost all areas, however, manufacturing is projected to account for a decreasing share of total civilian employment, reflecting a relatively rapid pace of productivity improvements and shifting consumer expenditures in favor of services.

The major water consuming and water polluting industries are chemicals, paper, primary metals, and food processing. Together these industries accounted for about 8 percent of the Basin's total employment and 28 percent of manufacturing employment in 1960. These industries are projected at a relatively slow growth resulting in decreasing shares of total civilian and manufacturing employment in the Basin area. When considering the demands placed on water resources by these industries, it should be noted that the prospective employment growth probably understates the increased water requirements, for output in these industries will increase at a much faster pace than employment and probably faster than savings in water use.

Finally, it is a conclusion of this study that the procedures developed for analysis and projections have proved successful and can be applied to other basins where planning requires economic and demographic projections. In addition, the same procedures can be used, at relatively little cost, to revise the projections presented in this volume as unfolding events and changing aspirations dictate the need for such revisions.

2.1 The National and Multistate Economies

A description of the potential progress of the national and multistate economies is important to an understanding of the Basin projections for two reasons. First, by comparing the Basin prospects with those for other areas a better understanding of the adequacy of existing water supplies and the requirements for added water capacities can be obtained. Secondly, the analytical procedures which have been adopted require quantitative estimates of the national and state economies in order to project the River Basin economies. The United States is a spatially integrated economy where impacts originating in one region are transmitted to other regions through a network of financial transactions, trade relationships, and population movements. Thus, a region is at least as much affected by events occurring outside as within its geographic boundaries.*

2.1.1 U.S. Economy

The events of the past few decades are testimony to the capacity of the U.S. economy for not only absorbing its ever increasing population but to do so at generally rising standards of living and declining hours of work. In the last three and a half decades the nation's production of goods and services (in real terms) has tripled. With population increasing by about 60 percent and employment by about 50 percent this has left room for a 75 percent increase in per capita consumption, a 400 percent increase in government services, a 140 percent increase in business investment, and a reduction of 8 hours in the average work week.

Basic to this growth of the American economy has been the rise in national productivity attributable to improvements in labor efficiency, growth in the quantity and quality of capital, technological innovations, and

*Detailed analyses and projections for the Nation, multistate region, Upper Mississippi River Basin and economic subregions are contained in Chapter IV, part II of Draft No. 2, UMRCBS Appendix P, Economic Base Study and Projections, June 1968.

advances in public and private management techniques. In the past two decades productivity has increased, on the average, by more than 3 percent per year. This national increase reflects productivity advances in each of the producing sectors of the economy although at varying rates; obscured by this aggregate figure is the fact that changes, not only for productivity but also for most variables, occur at different rates in different periods in our history.

Past growth, by itself, does not guarantee future growth. Study of the past does substantiate the judgment that the Nation's material and manpower resources and technological capacities have the potential for producing a growth in economic activity over the coming 30 years at least as great as the actual growth of the past decades. Whether this growth will actually occur depends on a number of factors. Two of these require emphasis. A large scale nuclear war will, of course, make the projections contained in this report irrelevant. But since such a conflict would also make this whole exercise trivial there is no choice but to assume the avoidance of such a war.

Second, increasing affluence and productive capacity may itself result in the desire by people to take a greatly increased share of productive efficiency improvements in the form of leisure rather than in the form of goods and services consumption. It is difficult, of course, to appraise the likelihood of such a major change in attitudes occurring over the next 50 years; results of this study, however, suggest that the best assumption to make is that this change will not occur. There are many unsatisfied material needs not only directly in low and middle income families, but also in meeting national aspirations for rising standards in such areas as health, education, housing, and community development, as well as the rising aspirations for the scientific developments of space and the material development of other countries. There is little evidence that technology improvements can be so rapid as to meet simultaneously these needs and permit a large scale withdrawal from the work force or reduction in the work week.

But even with the desire and the capability for maintaining high standards of production and employment, it will not come about unless there is proper public and private management of the national economy. In the last few years there was witnessed a demonstration of the capability of public policy joined with private action to achieve high levels of employment under conditions of noninflationary growth. The economy is currently going through a period testing whether such conditions can be maintained. The judgment that these levels can be reasonably maintained is expressed in the assumptions of reasonably full employment, rapid productivity improvements, and high labor participation—on the average—over the 60-year projected interval.

While the foregoing represents the fundamental assumptions about the future of the national economy, a summary in somewhat more detail of the actual procedures for making projections is appropriate. The study results are broadly in line with most other projections made by public agencies and private research groups.

In order to be more explicit about the policy alternatives facing the nation and other consequences for national economic development, the NPA has developed an approach to economic projections, which includes a "target" and a "judgment" estimate of the future.

> The *target* projection explores policies needed to achieve the fullest output and employment potentials of the economy. It is a normative projection, but one subject to the constraints both of existing institutional arrangements (e.g., absence of price or wage controls) and of economic feasibility.
>
> The *judgment* projection is a probabilistic one, allowing for shortfalls in pursuit of targets, on the one hand, and for adoption of new policies, on the other. The judgment projection represents a most likely set of estimates, one deemed particularly realistic and appropriate for business and public program planning purposes.

To illustrate the differences resulting from these projections it is found that GNP growth (in real terms) in the "target" projection comes to about 5.0 percent yearly over the next decade, a rate which could reduce the unemployment rate to 3 percent. The "judgment" projection shows an annual GNP growth of 4.5 percent, and an unemployment rate settling at 4.0 percent of the labor force.

From an evaluation of the "slippage" between "target" policy objectives and likely achievement, the judgment estimate emerges as a "best-guess" projection, appropriate for many planning purposes. The judgment projection need not have any fixed relationship to the "target" estimate; for its relationship to the "target" depends on given evaluation of policy prospects.

The judgment projections are those presented in this report and represent the general environment lying behind the state and Basin projections which have been made.

The following note describes in more detail the procedures for making the judgment projections.

> The judgment projections begin with U.S. Bureau of Census estimates of population by age and sex. The Series B estimates (which are used herein) assume a modest drop of age-specific birth rates

from the level of the 1950's and a completed average family size of about 3.2 children for all women who will have reached the end of their childbearing age by 1975 and leveling off to 3.1 children thereafter.

Adopting the most recent Bureau of Labor Statistics (BLS) projections of labor participation rates, the projected size of the labor force is obtained by applying these rates to Census Bureau estimates of future population levels by age and sex. Participation rate projections involve analysis of historic and prospective trends affecting the various age-sex categories. Factors examined include school enrollment patterns, labor force attachment by post childbearing females, and retirement practices. The projected long-term trends in participation rates abstract from the effect of cyclical fluctuations upon labor entry and departure; and they assume sufficiently high levels of economic activity and job opportunities as to bar "excessive" labor force withdrawal, while precluding such "emergency" conditions as would prompt "excessive" labor force entry.

Given the labor force projections, the NPA then determined employment by estimating an initial future unemployment rate in the light of technological considerations, components of labor force change, and prospects for government policies affecting levels of total demand and manpower skills.

Average weekly working hours are also projected—at first separately for the farm, manufacturing, nonmanufacturing, and government sectors, and then aggregated into appropriately weighted totals. Steadiness of past rates of change in average weekly hours for the total economy, accompanied by differing but convergent trends among the various industries, lends confidence to the projection. The likely future effect of longer vacations and increased part-time employment is also considered.

Man-hour productivity trends for major sectors of the economy are a convenient representation of the combined contributions to output of labor, capital, technological and managerial advances, and other factors. Productivity, although showing erratic annual variations because of capacity-utilization changes, displays fairly persistent and steady rates of change for extended periods. Controversy and uncertainty center on the question of whether this persistence can be safely interpreted only for the entire sweep of measured economic growth (say, the past 80 years or so), or whether there are distinct and characteristic changes (i.e., long waves) in the pace of productivity advance for different economic periods. This study holds to the latter view and, for purposes of 5- and 10-year projections, accords high weight to the statistical record of the postwar trend line and current technological experience and prospects.

The assumptions and information assembled to this point, along with analysis of output and employment trends by major sectors, are used to make a tentative estimate of projected GNP and employment, broken down into the contributions of the farm, manufacturing, nonmanufacturing, and government sectors of the economy. This permits a "supply-side" or "capacity" approach to the measurement of future economic activity. If desired, these estimates can be translated into an aggregate production function for the economy.

The tenability of this "supply-side" estimate of GNP is next judged in the light of prospective demand (or expenditures) by major sectors of the economy. (Of course, the capacity approach implicitly includes some tentative estimate of expected demands, since the labor participation, unemployment rate, and productivity change assumptions are dependent on such estimates.) A summary description of the more important steps follows:

(1) Technical relationships among output, employment, and capital stocks (i.e., a simple "production function" approximated from past trends) lead to an estimate of future capital requirements—hence, expenditures for plant and equipment.

(2) The observed near-constancy in the relationship between income and personal expenditures (the "consumption function") is used to project personal consumption expenditures under the specified GNP assumption. Trends in per capita and per household spending patterns for specific categories of goods and services are reviewed as a check on the assumed consumption total.

(3) Prospective expenditures for residential construction are based on estimated future household formation, age composition of the population, income changes, characteristics of the existing housing inventory, public housing policies, and other factors.

(4) Government expenditure projections are the result of separate analyses for various functions, including Federal defense spending, space, grants and transfers, and other Federal programs; and such state-local programs as education, highways, public health and sanitation, public utilities, community redevelopment, and general administration.

Even though these "first approximation" GNP expenditures are not independent of the GNP supply calculations, the fact that they are based on analysis of the separate demand sectors may uncover inconsistencies in the results. Thus, comparisons of the "expenditure-side" approximation of GNP with the "supply-side" GNP may disclose undue strains on, or unreasonable and unlikely under-utilization of capacity; or it may point to reasonable balance. Depending on the picture which emerges, a second round of "successive approximations" is used to calculate feasible and probable demand-supply relationships. One consideration in such a second approach might be the finding of

substantially higher unemployment than initially stipulated, this result would then be used to explore the likelihood of additional government policies under the indicated circumstances.

The final demand components (and subcomponents) of GNP are used to develop gross product originating (or "net output") projections for major industrial sectors. Extrapolations of historical data, regression equations relating final demands (say, total construction expenditures) to industry GNP (say in contract construction), and where possible, some interindustry calculations, are among the ways in which this is done. With overall GNP and employment as constraints, historical employee productivity estimates are projected forward on the basis of available industry analyses and information; successive approximations between industry outputs and productivities yield the projected industry distribution of employment and further analyses of occupational patterns leads to employment projections by occupational category.

2.1.1.1 Population

Population, which was about 180 million people in 1960, is expected to reach about 330 million by 2000 and 460 million by the year 2020. This represents an annual growth of about 1.5 percent for the four decades from 1960–2000 and about 1.7 percent in the last decades of the study period. Most of the projected growth is attributable to natural increase with a very small portion of foreign immigration.

The age distribution of the population is likely to shift at various intervals during the projection period. For example, while in 1950 the proportion of people under 15 was about 27 percent, by 1960 it was about 31 percent, and in 1980 is expected to decrease to 30 percent. During the last decade there has been a sharp decline in the share of population between the ages 15–34, while between 1960 and 1980 the trend is expected to reverse and show a sharp increase in this age group. In contrast the 35–55 year age brackets can be expected to decline in relative importance, from about 25 percent in 1960 to about 21 percent by 1980. The age brackets above 55 are expected to increase in relative importance through 1980 and decline slightly thereafter.

2.1.1.2 Income

Personal income in the nation (measured in constant 1960 prices) is expected to reach $2,200 billion by 2000 and about $4,800 billion by the year 2020, as compared with a 1965 level of $500 billion. While the annual increase in the last 30 years has been about three percent, it is projected at over four percent in the coming 30 years and slightly below 4 percent for the 30 years thereafter. The *Gross National Product*, of which personal income is only part (although a large part), is expected to pass $1,900 billion by 1990 and to exceed $6,000 billion by 2020 as compared with the current level of $675 billion.

Abstracting from the growth in population it is found that personal income per capita in 1960 was about $2,200. It is projected to reach $6,700 by 2000 and $10,500 by the year 2020. This rate of increase is much faster than the pace experienced in the past 30 years.

2.1.1.3 Labor Force

The labor force, currently at 78.5 million persons, is likely to reach 100 million by 1980 and approach 140 million persons by the turn of the century. These increases are attributable almost totally to the growth in population, with very little change expected for labor participation. However, the growth in female labor, is expected to be at a faster pace (although not larger in number) than the growth in male labor. This will be accompanied by a drop in the male labor participation rate with an offsetting increase for female labor participation.

2.1.1.4 Employment

Civilian employment is projected to reach almost 80 million persons by 1970 compared with 66 million in 1960 and 60 million ten years earlier. It is further projected to increase by about 15 million during the 1970's and another 14 million during the 1980's, representing an average annual growth rate of 1.6 percent during this 20-year period. By the end of the projection period–the year 2020–the Nation is likely to have nearly as many employees as it had people in 1960.

The overall growth in employment hides diverse movements in individual industries. In line with past trends, national employment declines are projected for agriculture, mining, communications, and transportation. However, the expected employment declines in mining and agriculture are likely to be much slower than since World War II, reflecting our expectation of a slowdown in the pace of improved mechanization and a simultaneous increase in demand for the resource-industry products.

The prospect for expanding employment opportunities in construction and manufacturing appears very favorable at least over the next two decades. Specifically, in spite of expected rapid advances in productivity.

employment in construction is projected to increase by more than three-fifths between 1960 and 1980, reaching a level of about six million by 1980 and more than twice this level by the year 2020. This increase is due to the stimulating effects of large increases in population and family formation, the desire for improved housing with higher incomes, the continuing mobility of population to urban centers, the large expected government outlays on social and overhead facilities, and the expanding private investment in plants.

Manufacturing employment should respond positively to the fairly sharp acceleration assumed for total output over the next two decades—a projected output growth in excess of four percent per year compared to the 3.7 percent for the postwar period. The projections indicate a manufacturing employment level of about 24 million by 1980 and 28 million by the turn of the century, compared with 17 million manufacturing employees in 1960. It should be noted that in spite of the accelerated pace projected for manufacturing employment gains over the past these increases will nevertheless be below the rate of increase projected for the combined noncommodity producing sectors in the economy.

Of the roughly 11 million manufacturing employment increase expected between 1950 and the turn of the century, about two-thirds is likely to occur in durable manufacturing industries. Of the growth in durables, well over two-thirds is accounted for by electrical machinery (SIC 36) and transportation equipment, chiefly motor vehicles and parts (SIC 371). The other durable industries with relatively fast employment growth include instruments and ordnance. Among the industries manufacturing nondurables, tobacco, textiles, petroleum refining, and leather are expected to experience absolute declines in employment, a continuation of past trends.

As in the postwar period, the bulk of future employment gains will come from the nongoods-producing sectors of the economy—services, trade, Federal, and state-local government, and finance-insurance-real estate. Within this sector, employment in services is expected to show the largest increase—a net addition of roughly 9 million jobs between 1960 and 1980 and another 10 million between 1980 and the turn of the century. The increase in government employment is expected to be about 8 million between 1960 and 1980, most of which is expected to originate in state and local governments as their concern with providing improved education, medical care, and other services to the growing population increases.* Transportation, communication, utilities, trade and finance employment is expected to grow at a slower pace than services, with employment increasing by 6 million between 1960 and 1980 and another 8 million to the year 2000.

2.1.1.5 Major Water Using Industries

The major water consuming and water polluting industries are chemicals, paper, primary metals, and food production. Together, these accounted for about 6.6 percent of total employment and 26 percent of manufacturing employment in 1960; by 1990, however, these industries are expected to account for less than 6 percent of total employment and roughly 23 percent of manufacturing employment. Overall employment in these industries is projected to grow by about 1.6 million persons between 1960 and 1990—with the food, paper and chemical industries each showing about a 500 thousand increase in employment while the primary metals industry is projected to remain almost stationary. When considering the demands placed on water resources by these industries, it should be noted that the employment growth probably understates the increased water requirements. For output in these industries will increase at a much faster pace than employment and probably faster than savings in water use.

2.1.2 The Multistate Economy

Having reviewed prospective developments in the national economy emphasis is now focused on an examination of the prospects for the six states in which the Basin area is located. The following note summarizes the procedures for developing the state projections:

> The national projections serve as control totals, and are the point of departure for the development of individual state estimates. The projected state distribution of the major indicators reflects an iterative approach which explicitly considers economic-demographic interactions. Procedurally, the steps can be summarized as follows: State "closed" population (i.e., considering likely natural increase, but ignoring immigration or emigration.) is estimated by age and sex, using trends in state-nation fertility and mortality relatives. State employment, by industry, is projected by allocating national industry employments through the use of "differential and proportional shift" analysis—i.e., evaluating each state's competitive potential and its share of slow or fast growing national industries. Trends in employment for nongoods industries are further evaluated in relation

*Public education employees have alternatively been classified in the services sector along with private education employees and in the government sector along with other public employees. In this section of the report public education employees are considered in the government sector; in the Section discussing the River Basin economy and the Statistical Section, they are considered part of the services sector.

to expected state population trends. Future state labor force is then obtained by assuming unemployment rates for each state.

A second estimate of population ("open population") is derived by using labor participation rates and state employment projections. As part of the participation rate analysis, special attention is given to "dependency" factors—that is, special circumstances (such as a disproportionate share, say, of retired persons) which characterize the demographic trends of given states.

A first approximation of state immigration or emigration, developed by taking the difference between "closed" and "open" population, is distributed by age and sex on the basis of modified historical trends and judgment. Overall net migration for given states is checked for reasonableness with past patterns. The final demographic and manpower estimates are established by successive refinement of open and closed population, using state-nation relatives in labor participation and unemployment rates as checks. The projected estimates of state personal income are derived from analyses of the industry distribution of state employment, the average employee compensation trends in these industries, and the interstate movements of personal income components.

2.1.2.1 Population

The six states comprising the Upper Mississippi region are not homogeneous but differ in economic structure, average income, and potential for growth. Agriculture has played a more important role in the economies of Iowa, Minnesota, Missouri, and Wisconsin than for the United States as a whole. This is reflected in the relatively low ratio of urbanization and, more importantly, by the slow growth of economic activities. Iowa was among the slowest-growing states in the nation, with a population growth of about 5 percent and employment and labor force increase of less than 2 percent over the 1950-60 decade. This relatively sluggish growth was associated with the heavy net emigration of people who left rural areas in search of job opportunities elsewhere. The outflow of people from the state is likely to continue due to the large population still remaining on farms and rural areas, but at a decreasing rate as agriculture decreases in relative importance and as employment opportunities in the nongoods sectors of the state economy continue their upward trends. These same phenomena may also explain the projected increase in the pace of population and employment growth of Missouri, Minnesota, and Wisconsin relative to their growth rates during the 1950's. Despited the assumed increase in the pace of economic activities, these states will continue to lag behind the rest of the Nation in economic expansion; this, however, is not likely to be the case for urban population and average per capita income where, in line with past trends, they are projected to grow faster than the national average; historically, Iowa, Missouri, Minnesota, and Wisconsin have had average income levels and urbanization ratios below those of the Nation as a whole.

Despite its favorable industrial structure, there was a considerable redistribution of economic activities away from Illinois during the postwar years. Measured by total net shift, this redistribution was estimated at roughly 300,000 persons over the 1947–65 period. The state experienced below average employment in almost all noncommodity industries, and this reflected, among other things, the relatively slow pace of income and population growth. No significant departures from these broad trends are expected to occur over the next two decades. In other words, the state is likely to continue to experience a competitive disadvantage in the location of almost all industries, and is likely to lose population through net emigration Moreover, per capita personal income, which has stood roughly one-fifth above the national average in recent periods, is expected to grow at a slower rate than the national average and to come closer to the national norm.

Indiana was the fastest growing state in the Upper Mississippi region during the last decade. Between 1950 and 1960 population in the state increased by 18 percent compared to 14 percent for the multistate region. There were similar trends in personal income and labor force during the same period. Compared to the Nation as a whole, however, Indiana has been a slow-growing state, and is likely to remain so in the foreseeable future. This does not hold true for urban population where the state is expected to grow relatively rapidly and to approach the national average in the ratio of urban to total population. Indiana like Iowa, Missouri, and Wisconsin has a lower rate of urbanization than the rest of the Nation.

2.1.2.2 Personal Income

The six state area as a whole is expected to continue to grow at a slower pace than the Nation. Thus, while the area had 16 percent of the nation's population in 1960, it is expected to have 15 percent by 1990 and 14 percent by the year 2020. Similar trends are shown for labor force, employment, personal income, and per capita personal income.

In absolute growth terms, however, these are very substantial increases in the multistate region. By the turn of the century the region is projected to have 49 million people, of whom 20 million will be in the work force, with

personal income of $330 billion and an average per capita income of $6800. These compare with 33 million people, 12 million employees, $65 billion personal income, and $2309 per capita income in 1960.

2.1.2.3 Labor Force

Differences between the multistate region and the Nation are also apparent for other indicators. Male labor participation in the multistate region is generally higher in the region than it is in the Nation, while there are no significant differences between the two areas in female labor participation. Average compensation per employee is projected to continue to remain higher in the region than in the Nation, although at a somewhat reduced level. Also wages and salaries are projected to account for a higher share of the region's income than that of the Nation, and this is in line with experiences of recent periods.

Associated with these trends are developments in specific industries. Agriculture, manufacturing and trade comprise larger shares of total employment in the economy of the multistate region than they do in the national economy. Offsetting this are smaller employment shares for services, government, contract construction, and finance-insurance-real estate; finally, the relative share of transportation-communication-public utilities is about the same in both areas.

2.1.2.4 Employment

An area's employment growth depends not only on the mix of industries which are active in the area but also upon how effectively each industry competes in national and regional markets. An area with a base of nationally declining or slow-growing industries has less opportunity for growth than one which has a "favorable" industrial structure - i.e., above average specialization in rapidly growing national industries. Moreover, the area may have a competitive advantage (disadvantage) in the location of specific industries, i.e., an industry in an area grows more rapidly (less rapidly) than the corresponding industry in the rest of the Nation.

The Upper Mississippi multistate region has had both an unfavorable industry mix and a comparative disadvantage in the location of most industrial sectors. Both of these factors contributed to the relatively sluggish employment growth in the region during the postwar years. Between 1947 and 1965, for example, civilian employment in the region increased by 16 percent compared to 25 percent for the Nation as a whole. Measured by the total net shift this employment redistribution is estimated at about 930,000 employees over the 1947-65 period. That is, if the region's employment had grown at the national rate, it would have increased its employment by nearly a million more than its actual increase. There were comparable population, labor force, and personal income redistributions away from the Upper Mississippi multistate region during this postwar period.

The region is expected to lag behind the rest of the Nation in its pace of total employment growth over the next three decades, reflecting an unfavorable industrial composition and below average growth on an industry-by-industry basis. However, for selected noncommodity industries we expect a particularly rapid pace of employment growth as a result of the increase in the pace of population and personal income growth. For example, services and government are projected to provide close to five million new jobs and to account for about two-thirds of the increase in total civilian employment between 1965 and the year 2000. Manufacturing and trade may provide an additional two million new jobs, although these industries are likely to decrease their shares of employment, as is the case with transportation-communication-public utilities and resource industries. Finance-insurance-real estate and construction are projected to account for an increasing share of the region's employment over the next few decades.

2.1.2.5 Major Water Using Industries

In 1960 the major water consuming industries in the multistate area accounted for 7.5 percent of civilian employment and 28 percent of manufacturing employment - slightly larger shares than those for the Nation. However, following national trends, these shares are expected to decline to 5.4 percent and 25 percent, respectively, by the year 2000. At this rate, employment in these industries will pass one million and exceed the 1960 level by about 200,000.

2.2 Projection Methodology

The selection of procedures for analyzing and projecting the economic and demographic characteristics of the Basin area was guided by the practical objective of providing sufficiently detailed information about those variables which are most useful to river basin planning. These include population, employment, income and labor force at varying levels of aggregation. In addition, the criterion was that the procedures be consistent with the best current thinking on the forces which make for regional change. Operationally, a form of export-base analysis was selected to incorporate this thinking into an approach which would maintain reasonable consistency between the changes in the

Basin area and other parts of the Nation; between the past growth in the area and its future prospects; and among the various indicators within the area which define its progress. In order to implement these objectives, it is necessary to identify, within the Basin areas, economic subregions which represent meaningful geographic units for analysis.

Effective analysis of the subregions should recognize that each is different from the others, confronted by its own problems, and has differing capabilities which influence its prospects. These differences relate primarily to the basic resources and production facilities in the area, its structure of economic activity, and the characteristics of its population and work force. It is not sufficient to identify such differences among areas. For, to a large extent, the prospects for a given area are determined by what happens in other areas and how the consequences of such external changes are transmitted to the area under study. There are several important methods of transmission which are closely interrelated. First, an area has trading relationships with other areas which are affected by market shifts and changes in production costs. Such changes can affect not only the types of goods and services which are produced for local consumption, destined for sales outside the area, or purchased from outside, but also affect the aggregate growth prospects for the area. Second, there are nationwide impulses which have a direct effect on specific areas, each of which is likely to be affected in differing degrees. For example, Federal economic policy with respect to promoting growth in employment and income will have differential consequences for each area; also, technological developments of new products or improved production processes will have fairly rapid effects on specific areas. Finally, there are migration relationships among areas which describe the movements of households and businesses from one area to another as they respond to differential economic opportunities among areas and by their very response cause further changes in these geographic differentials.

The procedures used for this study are designed to take account of these various influences by introducing a series of successive analyses for differing levels of geographic areas. Moving from one level to the next, account was taken of how differences among the areas were likely to create differential responses.

Starting with analyses for the Nation as a whole, projections of population, income, employment, output, and productivity were developed. Underlying these projections are expectations with respect to changes in demand, technology, public policy, and so forth. An assessment was then made as to how changes for each of the six states which include the Basin areas were likely to deviate from these nation-wide changes. For some changes, such as fertility rates, it was assumed that the historical trend toward the changing national norm would continue. For other changes, such as specific industry employment growth, account was taken of the states' past effectiveness in attracting the industry. For other changes, such as labor participation, the procedure not only accounted for such generally pervasive trends as a rising participation for women, but related these to the effect of changing industry mix on employment opportunities for women. And for still other changes, such as migration of households, emphasis was placed to make certain that they were consistent with the resources and past experiences of the states.

The multistate area represents a geographic unit which is closely related in two ways to the economic subregions within the Basin areas. First, the behavioral characteristics and resources of the subregions are "more like" those found in the multistate area than in the Nation. Second, to a large extent a subregion's markets, the places from which it purchases, and the places with which it competes for plants and households tend to be located in the multistate area.

To define the subregion boundaries in a manner consistent with the requirements of the analytical procedure, several criteria had to be kept in mind: the region should provide the major source of jobs for households residing in the area; the region should provide adequate service and shopping facilities for local residents; the region should be sufficiently different from surrounding regions in its resources and other assets so that management is not indifferent as to whether it expands capacity in one region or another; finally, the region should be defined so as to permit a reasonably clear distinction between the industries which customarily engage in interregional trade and those which do not. Operationally, it was found that the most appropriate single measure to meet these criteria was the wholesale trade market area which is influenced by the geographic distribution of population, shopping, and production centers and the time-distance relationships among these centers.

The examination of the prospects for a given subregion began by asking how the employment in specific industries which sell outside the area is likely to change. Part of this change is determined by the prospects for that industry in the multistate area, and part by the share of the multistate change which would occur in the subregion. Since the multistate industry employment projections are available from the multistate analysis, it was necessary to project the subregion's share. This was done by examining the 1950-60 trend in the subregion's share of multistate employment in the industry. Since such analyses were conducted at a fairly detailed level (3-digit SIC) they implicitly include consideration of changes in the comparative costs of production among regions and in the geographic location of markets.

The employment analysis for industries not engaged in interregional trade, that is, the residentiary industries serving households and business within the subregion, was made on a different basis. Generally, for each of these industries (again often on a detailed 3-digit basis) a relationship was established showing how much employment would be generated by a unit rise in subregion income. These relationships were derived from a cross-section analysis of 1960 data for the subregions. Thus, unless special circumstances dictated otherwise, the same relationship was used for a given industry in each subregion.

To use the regression equations it was necessary to project the income for each subregion. Part of this projected income was obtained from the wage and salary estimates derived from the interregional trade industry employment projections; another part was obtained from analyses of the nonwage and salary income, such as social security payments, unemployment insurance, property income, proprietor's income, and payments to armed forces stationed in the area. However, the major portion of income received in a region is associated with employment in the residentiary industries themselves. Therefore, it was necessary to develop a system which permitted a simultaneous solution of the income and employment in a region's residentiary industries.

These projections of industry employment in each region are essentially estimates of the demand for labor under assumptions about productivity change, industry and geographic market changes, and geographically differential cost changes. If population changes in an area were solely a function of economic opportunity, then population could be projected by establishing a direct relationship between employment demand and population growth. That is, immigration or emigration of workers and their dependents could be used as a balancing force to establish a consistency between population and employment growth. However, since growth in a region's population is partly independent of economic opportunity, and indeed often creates such opportunities, it is necessary to take this into account.

Regional population growth, which would occur if only natural increases (i.e. births less deaths) were accounted for, was projected by age, sex, and color. The fertility and death rate assumptions for each region were related to expected national trends. The labor force implied by the population estimate was then derived and compared with the employment demand estimate. Since male and female labor participation are significantly different, the employment demands and labor supply of each were estimated separately.

Large differences between the resulting demand and supply of labor estimates are to be expected and generally appeared in the study results. There are adjustemnt mechanisms which would operate to bring the labor market into balance. These include changes in unemployment changes in labor participation, shifts between male and female jobs, and finally immigration or emigration. In the model used herein it was assumed that migration (kept within reasonable limits) would represent the final adjustment mechanism.

Having calculated the initial labor imbalance, ranges were developed depicting acceptable rates of unemployment, and labor participation, based on past experience and cross-section analysis among all the regions. When the labor imbalance was large the labor supply was recalculated by permitting the unemployment and labor participation rates to approach their limits. For example, if the calculated labor supply estimate exceeded the labor demand by more than some reasonable amount the labor participation assumption was changed to its lowest acceptable level.

For most regions, these adjustments were not sufficient to eliminate the unbalanced labor market situation. The estimated imbalance was frequently the result of inconsistencies in the demand for labor by sex. As the next approximation the projected demands for males and females were adjusted separately without changing the demand for total employment, but rather shifting the projected employment between the sexes on the basis of past trends.

Finally, the migration required to reduce the remaining labor imbalances was estimated. The net migration for males in the labor force age brackets was first estimated; the female labor migration was related to the estimate for males; the children below labor force age were related to the family size and fertility of female migrants; and the migration of older persons outside the labor force was based upon the past rates for these age groups within each subregion.*

Historically, net migration estimates show a wide variation over time and among areas. In spite of this, the projected migration required to reduce the labor imbalance in some regions was out of line with past experience or expectations for the area. In such cases review of employment demand estimates was carried out to revise selected industry employment projections and carry through the implications for income, labor force, and population.

This basic model structure was first applied to develop the projections for 1970. The 1980 projections were then based on the same procedures, but using the additional 1970 results. Similarly, the 1990 projections used the 1980

*It should be noted that in evaluating the labor-demand and supply imbalance, account had to be taken of the fact that employment demand is on a job-count basis while labor force is on a person basis; also that the labor force excludes those small numbers in the labor force who are over 69. This was done internally within the computer model which made the necessary adjustments automatically.

estimates and the 2000 projections used the 1990 estimates. Projections beyond 2000 were made in less detail both in terms of the final outputs as well as in the techniques adopted.

Included in Chapters IV and V of Draft No. 2 of Appendix P are projections of selected industry productivity, and hydrologic area estimates for selected variables. A more detailed description of the methodological procedures used is also provided in Chapter III of Draft No. 2.

2.3 The Upper Mississippi Basin Economy

The past and projected changes in the economies of the Nation and the Upper Mississippi multistate region were summarized in the National and Multistate Economy Section. Several points were made:

(1) Given the prospects for rapid increase in the rates of technological developments and the timely enactment of appropriate government monetary-budget-manpower policies, the Nation is likely to enjoy a higher rate of stable economic growth over the next few decade. than it has achieved during the period since 1929;

(2) All regions will share in the prospective gains in economic expansion, particularly the Southeast, Southwest, and the Far West; and

(3) Due to its industrial structure and its competitive performance on an industry-by-industry basis, the Upper Mississippi multistate region is likely to continue its decline relative to national economic activity, although at a somewhat reduced pace.

This section briefly summarizes the prospects for economic growth in the Basin economy. Since the Basin area accounts for a preponderant share of the multistate region activities, future developments in the Basin would be expected to parallel roughly developments in the multistate region. This turns out to be the case, even though the Basin projections were obtained by different techniques than those of the multistate area. The Basin projections are obtained by aggregating the separate estimates for the 11 subregions. The projection procedures require that the Basin be divided into geographic subregions defined by specific economic criteria and that analysis be made for each of these subregions, separately. Although this section describes trends for the total Basin, brief descriptions of the past and projected trends for each of these 11 subregions are provided in the next section.

2.3.1 Population

The Basin area, historically, has accounted for the largest share of the multistate economy. In 1950, the Basin included 18 million persons, or 71 percent of the multistate region's population. by 1960, the number of persons within the region had increased to 21 million, about the same percent of the multistate region population as in the earlier decades.

The decadal growth in population was not uniform throughout the Basin area. During the 1950-60 decade the decennial rate of population change ranged from an increase of 25 percent for the Milwaukee subregion to a decrease of roughly 6 percent for the Northwest Minnesota subregion. After Milwaukee the subregions with a relatively high pace of population growth include Chicago, Minneapolis-St. Paul, and St. Louis; the subregions with actual decreases or slow growth of population during the 1950-60 period were Northeast Minnesota, Southwest Minnesota, Eau Claire, and Des Moines-Ft. Dodge.

The differences in the rate of population growth are attributable primarily to the size and direction of interstate migration. In the 1950-60 period there was a large migration of people (particularly those between the ages of 15 and 29 years) from predominantly rural areas to urban centers in search of more favorable employment opportunities. This pattern of migration partially explains the relatively high percentage of population in the younger and older age groups remaining within the predominantly rural subregions. The more industrialized and urbanized areas in the Basin were able to grow rapidly and to attract people from within and without the region; for example Chicago and St. Louis received a relatively large volume of nonwhite immigration from the South, and this is reflected in theshifting age and color compositions of the population in these subregions.

Projections developed in this study indicate two separate although related trends. First, the Basin as a whole is likely to increase its share of the population of the multistate region, from the 1960 level of 21 million or 72 percent of the multistate total, the River Basin population is projected to approach 40 million and to account for roughly 80 percent of the region's population by the year 2000. Secondly, differences among the subregions in the rate of population growth may decrease, reflecting, among other things, a comparable tendency toward similarity in industrial structure among the subregions; only rural Northwest Minnesota is expected to experience an absolute decrease in population, amounting to about 3 thousand persons over the next four decades.

2.3.2 Labor Force

The current labor force of eight million is expected to increase by about 1 million during the 1960's and roughly 2 million in each of the three subsequent decades.* The projections imply rapid rates of growth compared to those for the multistate region, they also imply a faster pace of growth than that achieved by the Basin during the last decade. Since the overall labor participation rate is expected to remain relatively constant, the growth will come from the increase in the population within the labor force age groups. Unlike the experience during the 1950's more males are expected to enter the labor force than females over the next three decades. This phenomenon, which holds true for the Basin as well as the Nation and the multistate region, may be explained by the shift in the age composition of population in favor of those with high labor participation, although offset in part by the secular decline in the rates of male participation. In line with past trends and the experiences of other areas in the Nation, the Basin female labor participation rates are expected to increase, although at a somewhat reduced pace. By the turn of the century the overall female participation rate in the Basin area is expected to reach 43 percent compared to 39 percent in 1960. These rates are higher than those for the Nation and the multistate region even when allowance is made for the difference in definition.

2.3.3 Income

Personal income received by the residents of the Basin area rose by more than one-third over the last decade, reaching a level of $51 billion (in 1960 price levels) and representing three-fourths of the income growth in the multistate region. The growth in real income was primarily the result of the appreciable increase in average employee compensation, although employment increases, particularly in noncommodity and manufacturing sectors also contributed to the aggregate income growth. The projected rate of growth of personal income developed in this study is more rapid than that achieved during the last decade, this is based on the expectation of a considerable pickup in the pace of employment growth and the upward trend in productivity resulting from a relatively rapid pace of technological developments. Between 1960 and the year 2000, constant dollar personal income in the Basin is expected to increase at an average annual rate of 4 percent, this is above the projected multistate growth rate but lower than the national rate.

Since population is expected to grow at an annual rate of roughly 1.6 percent, the annual rise in per capita income is about 2.5 percent above the growth during the 1950-60 interval. At this rate, per capita income will more than double between 1960 and 1990 and double again between 1990 and the year 2020.

Personal income per capita is currently much higher in the more industrialized and developed subregions (Chicago, Milwaukee, and Minneapolis) than it is in the less developed rural subregions. In line with past trends, however, a considerable narrowing of intersubregional differences in average income is expected, reflecting similar movements in industrial-occupational composition of labor force and in the degree of urbanization.

2.3.4 Employment

From its level of 8.3 million jobs in 1960, Basin employment is expected to approach 15 million by 1990 and to exceed 19 million at the end of the projected period.† This projection represents an average growth of about 1.5 percent, slightly higher than the growth rate achieved during the 1950-60 decade, but below the average growth rate expected for the Nation. About four-fifths of the multistate employment growth between 1960 and 1990 is expected to occur in the Basin, and no significant change in this contribution is projected to take place over the 1990-2020 interval. Currently the Basin employment is about 72 percent of the multistate employment, and this share is likely to reach 75 percent by 1990. The faster than average employment growth in the Basin is a continuation of the trend of more recent periods, and is comparable with the projected trends of the other indicators.

*The labor force data in the Nation and the multistate region follow the customary definition of persons 14 years and older who are willing, able, and seeking to work. In the River Basin and economic subregions, however, the labor force is defined to include persons 15 to 69 years of age who are willing, able, and seeking to work, as a result the labor force for the Basin and subregions has a downward bias relative to the national and multistate labor force, also, since persons past the age of 69 have a relatively low labor participation, it can be assumed that the labor participation rates shown for the Basin and subregions have an upward bias relative to their national and multistate counterparts.

†There are some definitional differences between the employment estimates shown for the Nation and the multistate region and those shown for the River Basin area and the economic subregions. The employment data relating to the Nation and multistate region represent a count of persons whereas the Basin and subregional employment are on a job-count basis. Because of the inclusion of dual job holders, the Basin and subregions employment estimates are definitionally higher than those in the Nation and the multistate region.

Overall employment growth in an area is dependent on diverse changes in export type industries and residentiary type industries. Export industries refer to those that sell their products outside the region. These usually include most of the commodity industries agriculture, mining, manufacturing but can include noncommodity industry divisions as well. As a consequence of increasing income and population concentration, and technological or managerial improvements permitting plant production to accommodate small market sizes, the share of export industries in total employment tends to fall in almost all regions. Residentiary industries, on the other hand, are those that sell to business and households within the region. These are usually the noncommodity industries, although they might also include some manufacturing. The noncommodity industry share of total employment is increasing throughout the Nation, primarily because of the shift of consumers' expenditures towards services as incomes rise, and also because productivity in these sectors increases at a slower rate than in commodity industries.

Residentiary employment is affected by the growth in export industries since local income is created by the export industries which is then spent on residentiary services. As a result, even though the export share of employment tends to decline, its multiplier effect, i.e., the ratio of total to export employment, tends to increase.

For the purpose of this study, the Basin export employment is defined as the sum of the economic subregions' export employment. As such, it includes not only the goods and services which are sold outside the Basin area but also the interregional sales of these industries.

Export employment in the Basin area increased 11 percent during the last decade, reaching about 3.9 million in 1960. The rate of increase was relatively slow so that the share of export employment in total employment declined from 48 percent in 1950 to 46 percent in 1960. The projections are based on the assumption that this trend will continue so that by 1990 the relative share of export employment may decline to below 40 percent. Residentiary employment increased at an average rate of 1.5 percent per year during the last decade reaching a level of 4.4 million in 1960. A projected increase in the pace of residentiary employment growth is sufficient to conclude that by the turn of the century the level of employment in these industries may exceed 9 million.

The above analysis necessarily implies a rising trend in the export multiplier; from a current level of roughly 2.2, the export multiplier is expected to reach 2.7 by the turn of the century. These ratios for the Basin correspond to similar computations made for other areas in the country.

It is instructive to review the employment trends in specific industrial sectors. It should be noted that although this description of trends is in terms of broad industry groupings, the projections were carried out in much greater detail, comprising about 160 industries at the 3-digit SIC level. It is also important to note that the Basin projections for agriculture, mining, lumber, wood products, and paper products were provided to the NPA by cooperating Federal agencies,* whereas the multistate and national projections for these industries were made by NPA on somewhat different assumptions.

2.3.4.1 Agriculture and Mining (SIC 01-14)

The relative importance of employment in agriculture and mining has declined in almost all areas of the United States under the influence of rapid gains in productivity and the relative inelasticity of demand for these industries' products. In the Basin area, the share of agriculture decreased from 12.5 percent in 1950 to 7.8 percent in 1960; these shares are slightly below those for the Nation and considerably below the multistate shares. Agricultural employment is expected to continue its absolute decline through 1980 and to increase moderately thereafter; in relative terms, however, the industry is projected to continue to account for a declining share of total employment. Mining currently accounts for an insignificant 0.4 percent of the Basin's total employment, and this holds true for the multistate region as a whole. Contrary to the experiences in more recent periods, mining employment is assumed to increase, although very moderately, reflecting an assumed slow-down in the pace of mechanization and an upward push in the demand for mining products, particularly metal mining which constitutes a good part of the mining activity in the area. Despite this, mining will still account for only a fraction of 1 percent of the projected Basin total employment.

2.3.4.2 T.C.P.U., Wholesale and Retail Trade, F.I.R.E. (SIC 40-49, 50, 52-59 and 60-67)

Transportation-communication-public utilities, trade, and finance-insurance-real estate are each expected to continue to play a more important role in the economy of the Basin area than they do in the economy of the Nation or the multistate region. Trade has been and is likely to remain the most important industry in this group, accounting for roughly one third of the Basin's total employment. Finance-insurance-real estate has been among the

*The farming component of "agriculture, forestry and fisheries" was projected by the Economic Research Service of the U.S. Department of Agriculture; mining by the U.S. Bureau of Mines, and wood products and paper products by the U.S. Forest Service.

fastest growing sectors in the Basin, growing at an average employment rate of 4.4 percent annually during the last decade and providing about 390,000 jobs by 1960; despite a considerable slow-down in the pace of employment growth, this industry is expected to continue to remain the fastest growing in the Basin and to account for an increasing share of total employment. In contrast, transportation-communication-public utilities may continue to represent a decreasing share of total employment, primarily because of the very rapid pace of labor-saving technological innovations in this industry.

2.3.4.3 Services (SIC 70-89)

During the past decade, the service industry has been among the fastest growing sectors of the Basin economy (as elsewhere). Nearly 400,000 new jobs were created in services, or about two-fifths of all new jobs added by all industries in the Basin during that period.* This change in the composition of employment is related in large part to the consumer purchasing habits, as was indicated earlier. As income increases consumers tend to spend more money for services of all kinds--education, recreation, medical services, repairs, household help, etc. The same factors are expected to be operative in maintaining the future high rate of employment growth in services. From the 1960 level of 1.6 million, employment in this industry is projected to reach 4.6 million; this represents an average annual growth rate of 2.7 percent, well over the rate projected for total employment, and slightly higher than the comparable rate of service employment growth expected for the multistate region.

2.3.4.4 Government (SIC 91-93)

Government employment in the Basin region is relatively low. In 1960 it accounted for 4 percent of civilian employment compared to 6 percent for the multistate region and 8 percent for the Nation. The Basin is projected to continue to have a relatively low share of government employment, even though it increases to 7 percent in 1990 and approaches 8 percent by the year 2020. The relatively lesser importance of government in the Basin area may partly be explained by the fact that it includes primarily local government employment, since there is relatively little Federal government employment in the area. (It will be recalled that public education employment has been assigned to the service sector.) Local government is expected to be a rapidly growing sector in the coming decades, as reflected in the projected rate of employment growth within the Basin area of 2.9 percent annually.

2.3.4.5 Construction (SIC 15-17)

Employment in contract construction increased from about 370,000 to 430,000 between 1950 and 1960; this represents an average annual growth rate of 1.4 percent, the same as that for the Nation, but well above the growth rate achieved by the multistate region during the same period. Employment in this industry should respond positively to the expected pickup in the rate of income growth, the projected increase in total population, and the continuing mobility of population to urban centers. Thus, between 1960 and 1980 construction employment is projected to grow at an average rate of 1.7 percent per year which is higher than the growth rate assumed for total employment. Thus, employment may reach 600,000 in 1980, exceeding the 1960 level by 160,000. A further gain of roughly 200,000 persons may occur over the 1980-2000 period.

2.3.4.6 Manufacturing (SIC 19-39)

Due to the relatively large importance of the Chicago, Milwaukee, and St. Louis subregions, manufacturing has accounted for a larger share of employment in the Basin area than it has in the Nation and the multistate region. The share of manufacturing in total employment, however, has declined in the Basin, Nation, and multistate region during the last decade because of the relatively rapid pace of productivity improvements and the depressed economic conditions in the second half of the 1950's. In 1950 manufacturing accounted for 32 percent of the total civilian employment in the Basin, or 6 percentage points above the national share, while by 1960 it had declined to 29 percent or 3 percentage points above the national share. Looking towards the future, manufacturing employment in the Basin is expected to drop to 22 percent by the turn of the century, about the same as the national share of employment.

Within manufacturing, nondurables currently account for roughly 1.6 million jobs, representing about 65 percent of total manufacturing employment. In line with the postwar trend, a more rapid pace of employment growth is projected for durables than for nondurables so that by the year 2000 durables may rise to 70 percent of total manufacturing in the Basin.

*See footnote on page P-64.

Compared to many other areas in the Nation, the durable production in the Basin is highly diversified. The largest durables industry is nonelectrical machinery which employed 350,000 persons or roughly a quarter of the durables employment in 1960. it is projected to reach 412,000 or about one-fifth of durables employment by the year 2000. Electrical machinery is the second largest employer, ranking second to the instrument industry in terms of growth for both the historical and projected periods. Lumber and ordnance which are among the smallest durables industries in the Basin are projected to experience an actual decrease in employment over the next several decades. Finally, primary metals, stone-clay-glass, and miscellaneous manufacturing are likely to remain slow-growing industries accounting for decreasing shares of durables employment.

Food processing, printing-publishing, and chemicals have accounted for about two-thirds of nondurables employment in recent years. Employment in food processing is expected to remain almost stationary, reflecting, among other things, the relatively inelastic demand for the products of this industry. Printing and publishing are projected to be among the relatively rapidly growing nondurables industries. Rubber, as in the past, is projected to be the most rapidly growing nondurables industry, while paper products are also projected to grow rapidly. The other nondurables industries textile mill products, apparel, petroleum refining, and leather products are expected to decline both absolutely and as a percent of manufacturing employment over the projected period.

The major water consuming industries in manufacturing–chemicals, paper, primary metals, and food processing comprised about 28 percent of total manufacturing employment in the Basin, this is expected to fall to 25 percent by the year 2000. Taken together, these industries show an increase in jobs of about 100,000 during this 40-year period.

2.4 Economic Subregion Profiles

This section contains a brief description and statistical profile of the 11 economic subregions which comprise the Upper Mississippi River Basin. For each subregion the significant past and projected trends in population, income, and labor force are summarized.* The analyses of subregions contained in this section of the summary report are based on detailed data reported in Chapter IV, Section 2 of Draft No. 2, Appendix P. Also noteworthy is the varying definition of employment; Basin and subregion employment data are on a job-count basis, while national and multistate employment are on a person-count basis. Regional labor force data include persons in the labor force from ages 14 to 69. The relationships among these variables are also discussed with a comparison of subregion past and projected performance to the national, multistate and Basin trends. The accompanying location map, *Figure P-23*, and corresponding *Table P-49* show, respectively, direction of population change in counties from 1940 to 1960 and counties included within each subregion.

An explanation of the forces behind the prospective developments for each subregion requires an understanding of two related phenomena. First is an explanation of the reasons for change in the structural relationships in the subregion. For example, if per capita income is expected to grow relatively rapidly, this can be "explained" by such factors as an expectation of rapid growth in average wage and salaries, or increase in labor participation, or slow growth in the number of children, or rapid rise in income transfers to the aged. Such "explanations" are provided in the subregion profiles but are not sufficient. For lying behind these forces are still other factors determining their trends.

Probably the most significant factor is the expectation for employment (job) opportunities in the subregion. These expectations are, of course, influenced by the forces mentioned earlier in a continuous feed-back process. But more important they determine the trends in these forces. Employment developments not only affect the structural relationships in the subregion but in a very real sense they determine the overall "size" of the regional economy, and whether the subregion will change its size at a pace significantly different from other subregions. Therefore, a secondary requirement is an explanation for likely employment developments for specific industries. Consequently an attempt has been made to show how the prospects for important industries in the subregion are related to prospects for comparable industries in the multistate area. That is, the competitive shift effects are discussed, particularly for export type industries. The prospects for residentiary industry employment are then explained in terms of export employment, income, and population developments.

2.4.1 The Peripheral Economic Subregions

Three peripheral subregions include only a small number of counties within the Basin service area and have extensive areas outside the Basin. Maintaining these subregions intact would have meant a significant increase in the amount and cost of data which had to be collected and processed for the economic base study. It was decided that

*See footnote on Page P-57

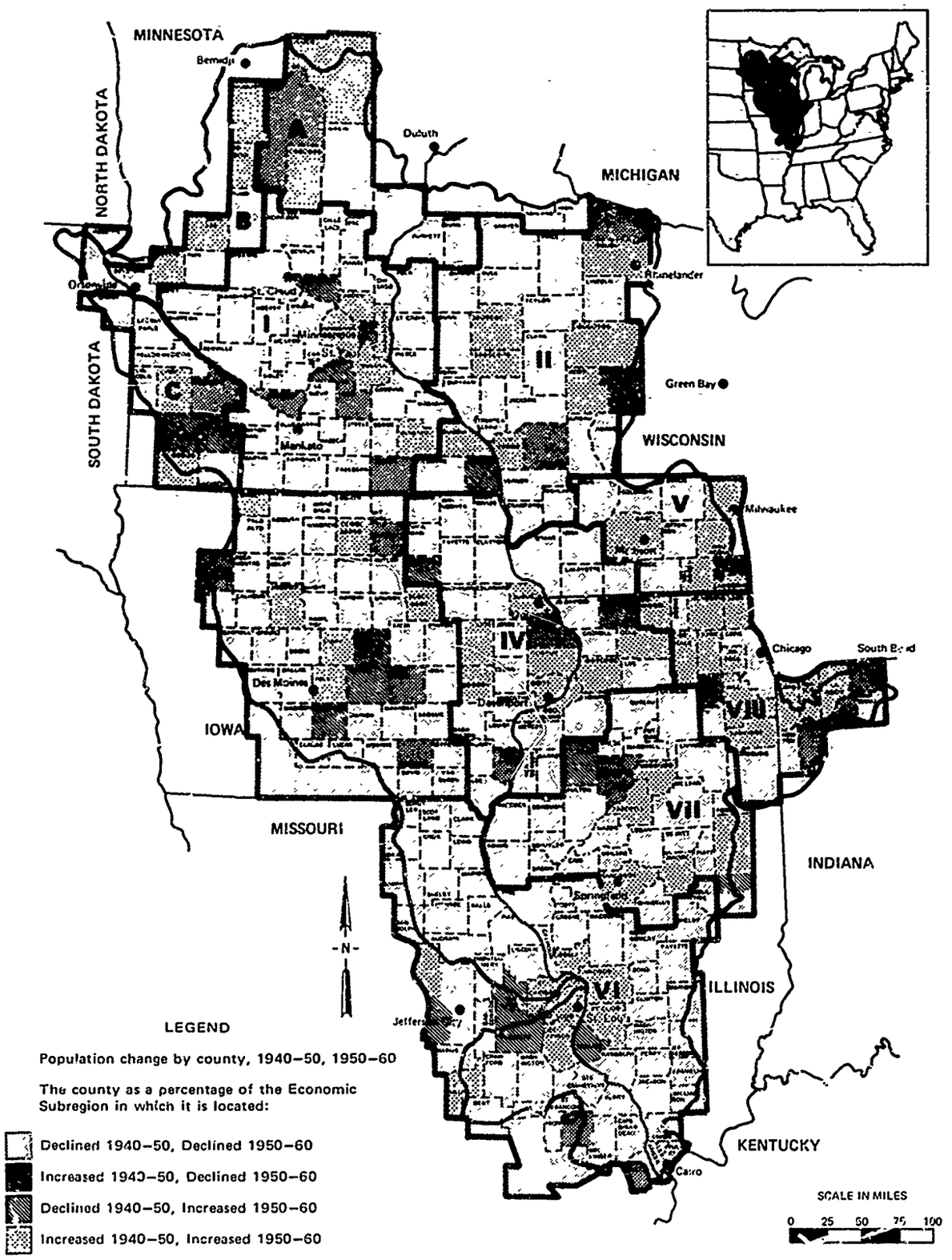

Figure P-23. Upper Mississippi River Basin economic subregions.

Table P-49

Counties Included in Each Economic Subregion

County	Included in Plan Area
Northeast Minnesota (NPA Code 1, Map Code A):	
Aitken	1
Cass	1
Crow Wing	1
Itasca	1
Pine	1
Burnett	1
Washburn	1
Northwest Minnesota (NPA Code 2, Map Code B):	
Big Stone	16
Douglas	16
Hubbard	1
Pope	16
Stevens	16
Todd	1
Wadena	1
Roberts	16
Southwest Minnesota (NPA Code 3, Map Code C):	
Cottonwood	16
Jackson	11
Lac Qui Parle	16
Lincoln	16
Lyon	16
Murray	11
Nobles	11
Redwood	16
Yellow Medicine	16
Grant	16
Minneapolis-St. Paul (NPA Code 4, Map Code I):	
Anoka	1
Benton	1
Blue Earth	16
Brown	16
Carver	1
Chippewa	16
Chisago	1
Dakota	1
Dodge	15
Faribault	16
Freeborn	13
Goodhue	15
Hennepin	1
Isanti	1
Kanabec	1
Kandiyohi	1
Le Sueur	16
McLeod	1
Martin	16
Meeker	1
Mille Lacs	1
Morrison	1
Mower	13
Nicollet	16
Olmsted	15
Minneapolis-St. Paul (con.)	
Ramsey	1
Renville	16
Rice	15
Scott	1
Sherburne	1
Sibley	16
Stearns	1
Steele	15
Swift	16
Wabasha	15
Waseca	16
Washington	1
Watonwan	16
Wright	1
Pierce	1
Polk	1
St. Croix	1
Eau Claire (NPA Code 5, Map Code II):	
Fillmore	15
Houston	15
Winona	15
Adams	3
Barron	2
Buffalo	2
Chippewa	2
Clark	2
Crawford	3
Dunn	2
Eau Claire	2
Jackson	2
Juneau	3
La Crosse	3
Lincoln	3
Marathon	3
Monroe	3
Oneida	3
Pepin	2
Portage	3
Price	2
Richland	3
Rusk	2
Sawyer	2
Taylor	2
Trempealeau	2
Vernon	3
Vilas	3
Wood	3
Des Moines-Fort Dodge (NPA Code 6, Map Code III):	
Adair	(a)
Appanoose	(a)
Benton	13
Black Hawk	13
Boone	11
Buena Vista	11
Butler	13

Table P-49 (con.)

County	Included in Plan Area
Des Moines-Fort Dodge (con.)	
Calhoun	11
Carroll	11
Cerro Gordo	13
Clarke	11
Dallas	11
Davis	11
Decatur	(3)
Emmet	11
Floyd	13
Franklin	13
Greene	11
Grundy	13
Guthrie	11
Hamilton	11
Hancock	13
Hardin	13
Humboldt	11
Iowa	13
Jasper	12
Jefferson	12
Keokuk	12
Kossuth	11
Lucas	11
Madison	11
Mahaska	12
Marion	11
Marshall	13
Mitchell	13
Monroe	11
Palo Alto	11
Pocahontas	11
Polk	11
Poweshiek	13
Ringgold	(3)
Sac	11
Story	12
Tama	13
Union	(3)
Van Buren	11
Wapello	11
Warren	11
Wayne	(3)
Webster	11
Winnebago	13
Worth	13
Wright	11
Davenport-Rock Island-Moline (NPA Code 7, Map Code IV):	
Grant	4
Green	4
Iowa	4
Lafayette	4
Carroll	4
Henderson	4
Henry	4
Jo Daviess	4
Lee	4
Mercer	4
Ogle	4
Davenport-Rock Island-Moline (con.)	
Rock Island	4
Stephenson	4
Warren	4
Whiteside	4
Allamakee	14
Bremer	14
Buchanan	14
Cedar	13
Chickasaw	14
Clayton	14
Clinton	14
Delaware	14
Des Moines	12
Dubuque	14
Fayette	14
Henry	12
Howard	14
Jackson	14
Johnson	13
Jones	14
Lee	11
Linn	13
Louisa	13
Muscatine	13
Scott	14
Washington	12
Winneshiek	14
Milwaukee (NPA Code 8, Map Code V):	
Columbia	3
Dane	4
Dodge	4
Jefferson	4
Kenosha	5A
Milwaukee	(3)
Ozaukee	(3)
Racine	5A
Rock	4
Sauk	3
Walworth	5A
Washington	5A
Waukesha	5A
Chicago (NPA Code 9, Map Code VIII):	
Boone	4
Cook	5A
De Kalb	4
Du Page	5A
Grundy	5B
Iroquois	5B
Kane	5A
Kankakee	5B
Kendall	5B
Lake	5A
McHenry	5A
Will	5A
Winnebago	4
Jasper	5B
Lake	5A

Table P-49 (con.)

County	Included in Plan Area
Chicago (con.)	
La Porte	5B
Marshall	5B
Newton	5B
Porter	5A
Starke	5B
St. Joseph	[a]
Peoria (NPA Code 10, Map Code VIII):	
Adams	5B
Brown	5B
Bureau	5B
Cass	5B
Champaign	[a]
Christian	5B
Coles	[a]
De Witt	5B
Douglas	[a]
Ford	5B
Fulton	5B
Hancock	5B
Knox	5B
La Salle	5B
Livingston	5B
Logan	5B
McDonough	5B
McLean	5B
Macon	5B
Marshall	5B
Mason	5B
Menard	5B
Peoria	5B
Piatt	5B
Putnam	5B
Sangamon	5B
Schuyler	5B
Stark	5B
Tazewell	5B
Woodford	5B
St. Louis (NPA Code 11, Map Code VI):	
Alexander	7
Bond	6
Calhoun	5B
Clinton	6
Fayette	6
Franklin	7
Greene	5B
Jackson	7
Jefferson	7
Jersey	5B
Macoupin	5B
Madison	6
Marion	6
Monroe	6
Montgomery	6
Morgan	5B
St. Louis (con.)	
Moultrie	6
Perry	7
Pike	5B
Pulaski	7
Randolph	6
St. Clair	6
Scott	5B
Shelby	6
Union	7
Washington	6
Williamson	7
Adair	9
Audrain	9
Bollinger	8
Boone	[a]
Callaway	[a]
Cape Girardeau	8
Carter	[a]
Clark	10
Cole	[a]
Crawford	8
Dent	8
Franklin	8
Gasconade	8
Iron	8
Jefferson	8
Knox	10
Lewis	10
Lincoln	9
Macon	9
Madison	8
Maries	8
Marion	10
Monroe	9
Montgomery	9
Osage	[a]
Perry	8
Phelps	8
Pike	9
Ralls	9
Randolph	9
Reynolds	[a]
St. Charles	9
St. Francois	8
St. Louis	8
St. Louis City	8
Ste. Genevieve	8
Schuyler	10
Scotland	10
Scott	8
Shelby	9
Warren	9
Washington	8
Wayne	[a]

[a] Not included in any plan area.

the direction of influence on economic activities went from the counties within the Basin to the outlying urban centers. In general, these counties had low densities of population and were dominantly agricultural. A satisfactory analysis of the economic and demographic characteristics of each of these groups of counties could be made independently of the changes which might be taking place in the urban centers to which they were linked. Consequently, these subregions were truncated and they include only the counties within the Basin service area.

2.4.1.1 Northeast Minnesota Economic Subregion (NPA Code 1, Map Code A)

The Northeast Minnesota subregion includes five counties in Minnesota and two counties in Wisconsin. The 1960 population was about 136,000, a small decrease from the 1950 level. As shown in *Table P-50* the population is projected to decrease until 1970 and then to begin an increase, reaching 174,000 by the year 2000.

(1) Population In the 1950's, population decreased by 0.3 percent per year, as compared with increases of 1 to 2 percent annually in the Basin, the multistate area and the Nation. The decrease in population was associated with substantial emigration concentrated among the younger age groups. About 60 percent of the emigrants were persons 15 to 34 years of age and most of the remainder were of children under 15 years old. Only the 65-and-over age group exhibited a gain in numbers over the decade.

In the 1960's a decrease in population is expected to continue at an accelerated pace, the subregion losing population at a rate of 1.3 percent annually. Nearly all the emigration associated with the population decline is expected to be by persons under 35 years old. The population growth projected after 1970 will be accompanied by some emigration, but will not match the growth of the Nation; after 1980 the region's growth is expected to equal the approximately 1.5 annual percent increases of the total multistate and Basin areas.

(2) Labor Force – The labor force and labor participation rate are both expected to decline between 1960-1970. This is associated with the emigration of the age groups with high labor force attachment. After 1970 the labor force is expected to increase at a slowly increasing rate, eventually growing faster than those of the multistate and total Basin areas, but not as rapidly as that of the Nation. Female labor participation is expected to continue to be considerably lower than its counterpart at the national, multistate or Basin level, while the male participation rate is projected to be closer to the rates for these areas.

(3) Income – Personal income per capita in the subregion increased at about the rate of the Nation, multistate region and total Basin area between 1950-1960, and has also increased faster than its counterpart in any of the other subregions in the Basin. However, in 1960 the level of per capita income was still only about two-thirds of the national level and a smaller percentage of the multistate and Basin levels; the region had one of the lowest per capita income levels of all subregions in the Basin. While per capita personal income is expected to increase more rapidly than in the Nation, multistate, or Basin areas in the future, it is expected to reach only four-fifths of the national level by 2020. The relatively low per capita income in the region can be ascribed to the consistently higher dependency ratio (persons per employee) in the subregion than in the Nation, multistate and Basin area and to the high proportion of agricultural employment in the subregion. Because of slow population growth between 1960-1980, total personal income in the region is not expected to increase as fast as in the Nation, multistate or Basin; after 1980 it is projected to increase at about the same pace as in these other areas.

(4) Employment Civilian employment in the subregion is expected to grow at a rate of slightly more than 1 percent per year, after having declined to 2 percent per year in the 1950's. The projected growth rate, however, is slower than the rates for the Nation, multistate and Basin areas.

Employment in industries serving the subregion population, i.e., residentiary employment, is expected to increase faster than export employment. Export employment is expected to increase at a gradually declining rate while residentiary employment is projected to rise at an increasing rate from decade to decade. Part of this employment growth is due to the projected growth in total and per capita income.

The percent decline of agricultural (including forestry and fisheries) employment in the 1950's accounted for more than the total employment drop in the subregion during that decade. Government, retail trade and manufacturing employment all increased slightly to limit the decline in total employment. Agriculture is projected to decline still further, while government, retail trade and manufacturing are projected to increase. Services are expected to grow very rapidly, replacing

Table P-50

Selected Summary Data,
Subregion 1 — Northeast Minnesota
(NPA Code 1, Map Code A)

	Unit	1950	1960	1970	1980	1990	2000	2010	2020
Population	thousands	138	136	120	128	149	174	201	234
Students	thousands	–	–	–	–	–	–	–	–
Total, excluding students	thousands	138	136	119	128	149	174	–	–
Male	thousands	72	70	60	63	74	86	–	–
Female	thousands	66	66	60	65	76	87	–	–
Total, 15–69 yrs. excl. students	thousands	88	81	74	77	87	103	–	–
Male	thousands	46	41	37	38	43	52	–	–
Female	thousands	42	40	37	39	44	52	–	–
Total, excluding rural farm	thousands	84	104	91	103	129	159	187	222
Labor Force:									
Total	thousands	–	45	39	42	47	55	–	–
Male	thousands	–	33	28	31	34	40	–	–
Female	thousands	–	12	11	12	13	15	–	–
Labor Force Participation Rate:									
Total	percent	–	54.2	52.4	54.9	54.4	53.6	–	–
Male	percent	–	78.1	75.9	80.5	79.3	77.5	–	–
Female	percent	–	29.7	28.9	29.9	29.8	29.6	–	–
Employment (jobs):									
Total	thousands	43	35	39	43	49	55	62	70
Export	thousands	23	17	18	19	20	20	–	–
Residentiary	thousands	20	18	21	24	29	35	–	–
Total Employment (persons)	thousands	–	–	37	41	46	52	–	–
Unemployment Rate	percent	6.6	10.0	5.4	2.5	2.4	5.4	–	–
Personal Income:									
Total	mil. 1960 $	135	194	274	399	590	897	1,333	1,939
Wages and salaries	mil. 1960 $	87	126	179	261	387	589	–	–
Other income	mil. 1960 $	48	68	96	138	203	308	–	–
Per capita	1960 $	976	1,401	2,296	3,118	3,952	5,170	6,635	8,295
Wages and salaries per employee	1960 $	2,035	3,613	4,623	6,037	7,965	10,695	–	–

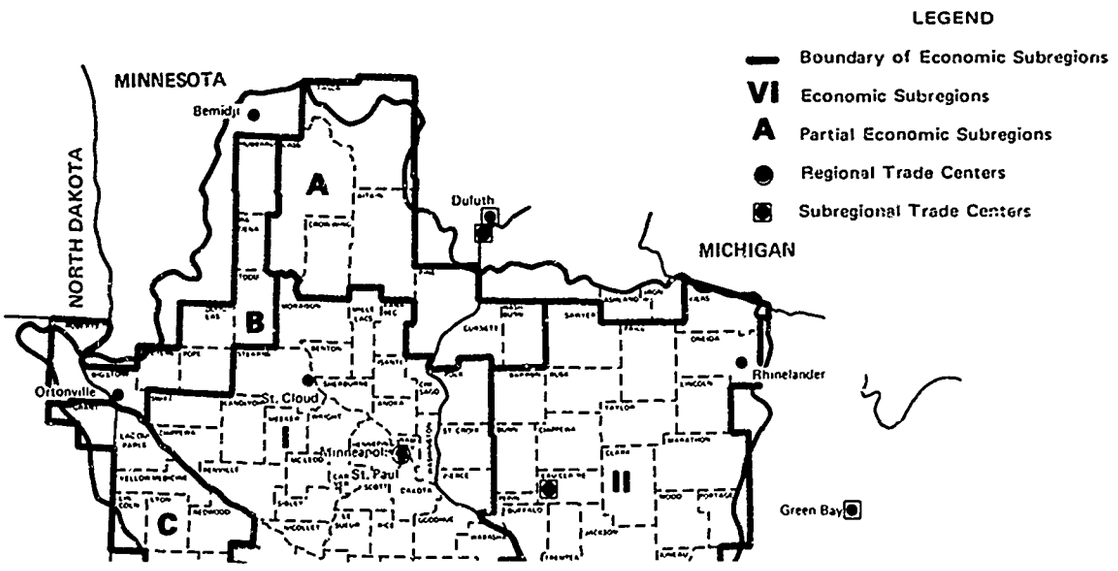

Figure P-24. Upper Mississippi River Basin Economic Subregion 1.

agriculture as the largest employer by 1970. By 1990 manufacturing is expected to become the second largest employer. Mining is the only other industry of substantial size in the region, accounting for 9 percent of employment in 1960. Mining is expected to increase gradually, although the rate of increase will be less than the rate for total employment in the subregion.

The combined lumber and pulp and paper products industry is the major manufacturing source in the area. The pulp and paper products industry is expected to increase its employment and surpass lumber products as the major source of manufacturing employment by 1970. Lumber products, on the other hand, are not expected to increase their employment after 1970.

Noncommodity employment in this rural region has been increasing as a proportion of total subregion employment as local markets grow. This trend is projected to continue even though it is not expected to reach the share noncommodity employment represents in the Nation, multistate or Basin areas. The major noncommodity industries are services, retail trade and government, all expected to grow more rapidly than other industries in the subregion.

2.4.1.2 Northeast Minnesota Economic Subregion (NPA Code 2, Map Code B)

The Northwest Minnesota subregion includes seven counties in Minnesota and one county in South Dakota. The population in 1960 was 112,000, down from nearly 120,000 in 1950. As shown in *Table P-51*, the population is expected to continue to decrease until 1980, then begin to rise, reaching 113,000 by 2020.

(1) Population The 1950-60 population decline in the subregion at a rate of more than 0.5 percent per year was the most rapid of all subregions in the Basin. The decline was associated with the rapid emigration of the population under 55 years of age. With no large urban areas in the subregion which attracted migrants, rural emigrants were lost to other areas. The flow of migrants out of the subregion is projected to continue although, after 1980, the rate of emigration will be less than the natural increase, permitting the population to grow.

(2) Labor Force In association with the projected population loss between 1960 and 1980, the labor force is also expected to decline, at a higher pace during the first decade than in the second. Between 1980 and 1990, even though the population is projected to increase, the labor force is expected to decrease, the population gain in this decade being entirely attributable to persons younger than 15 years of age. In the decade of the 1990's the labor force is expected to increase, but at a rate about one-third of the national, multistate and Basin gains for this decade.

The participation of the total population in the labor force is expected to remain higher in the subregion than in the Nation or multistate area, but lower than in the total Basin. This is due to a very high labor participation rate for men, women exhibiting less labor force attachment than the average for the Nation, multistate and total Basin area.

(3) Income Personal income per capita, expected to increase at a generally faster pace than in the Nation, multistate and Basin areas, converges toward the norms for these areas; however, even by the year 2020 it reaches only three-fourths of the multistate area's per capita income, the lowest of any of the Basin's subregions. Total personal income, because of the slow growth of population, is expected to increase more slowly than personal income in the Nation, multistate and Basin areas.

(4) Employment Civilian employment in the decade of the 1950's ran counter to the trend of population and labor force, its slight increase, however, was substantially less than the rate for the total Basin area. Employment and labor force are projected to increase slightly in the 1960's, and then decline slightly until 1990, after 1990 employment is expected to resume its gradual increase, although not approaching the rate of increase for the Nation, multistate or Basin areas. Employment in industries exporting their goods or services from the region did not change between 1950-60 but is expected to decline slightly in the future. Residentiary employment, as in the past, is expected to continue to increase gradually. As a result, the export multiplier (total employment divided by export employment) is expected to increase, but not reach the level of the total Basin's export multiplier.

Agriculture (including forestry and fisheries) is the major employer of the subregion, accounting for nearly half the employment in 1960. While agricultural employment is expected to decline in the future, it will still be the largest industry by the turn of the century, giving way only to services thereafter. By 2020, agriculture is expected to employ nearly one-fifth of the subregion's workers.

Table P-51
Selected Summary Data, Subregion 2 — Northwest Minnesota (NPA Code 2, Map Code B)

	Unit	1950	1960	1970	1980	1990	2000	2010	2020
Population	thousands	119	112	99	99	102	104	109	113
Students	thousands	–	–	–	–	–	–	–	–
Total, excluding students	thousands	119	112	99	99	102	104	–	–
Male	thousands	62	57	49	48	50	51	–	–
Female	thousands	57	55	50	50	52	53	–	–
Total, 15–69 yrs. excl. students	thousands	75	66	61	59	58	61	–	–
Male	thousands	39	34	30	29	28	30	–	–
Female	thousands	36	32	31	30	30	31	–	–
Total, excluding rural farm	thousands	58	64	55	59	67	74	83	91
Labor Force:									
Total	thousands	–	41	36	35	34	37	–	–
Male	thousands	–	30	25	25	24	26	–	–
Female	thousands	–	11	11	11	10	11	–	–
Labor Force Participation Rate:									
Total	percent	–	60.1	59.3	60.2	59.4	59.9	–	–
Male	percent	–	86.1	83.9	86.3	85.2	85.2	–	–
Female	percent	–	33.1	35.4	35.4	35.0	35.5	–	–
Employment (jobs):									
Total	thousands	35	36	36	35	35	37	38	38
Export	thousands	20	20	19	18	17	16	–	–
Residentiary	thousands	15	15	17	18	18	21	–	–
Total Employment (persons)	thousands	–	–	34	34	33	35	–	–
Unemployment Rate	percent	3.7	6.1	4.9	4.9	4.9	4.9	–	–
Personal Income:									
Total	mil. 1960 $	129	153	208	270	354	497	683	901
Wages and salaries	mil. 1960 $	87	100	137	178	234	328	–	–
Other income	mil. 1960 $	42	52	71	92	120	169	–	–
Per capita	1960 $	1,086	1,366	2,098	2,725	3,486	4,774	6,274	7,976
Wages and salaries per employee	1960 $	2,511	2,828	3,814	5,054	6,757	8,970	–	–

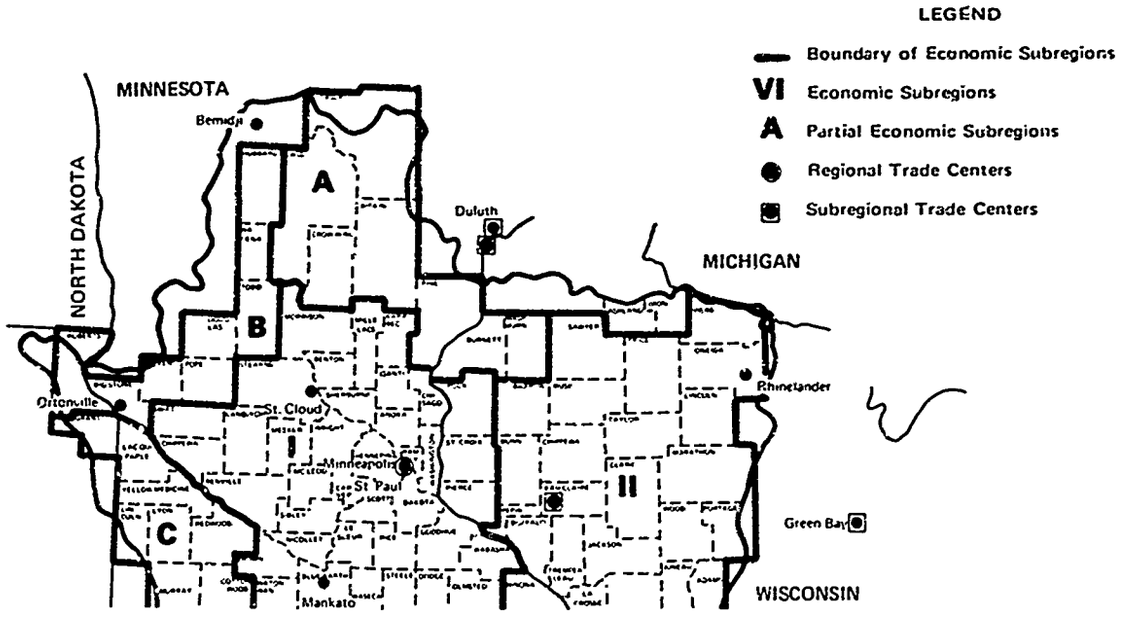

Figure P-25. Upper Mississippi River Basin Economic Subregion 2.

Mining, wholesale trade, finance, insurance, and real estate together employ only about 5 percent of the workers currently and, by the year 2020, are expected to account for about 9 percent. Manufacturing industries currently employ very few workers in the subregion and, although projected to increase, will remain a small employer. The food and related products industry employs more than half of manufacturing workers and is expected to continue as the largest manufacturing employer.

Services and government are expected to show the most rapid increases in the future, nearly doubling by the year 2020 and representing 40 percent of the total employment in that year. Retail trade, construction, transportation, communications, and public utilities are all expected to increase at about the same rate as total employment in the area.

2.4.1.3 Southwest Minnesota Economic Subregion (NPA Code 3, Map Code C)

The Southwest Minnesota subregion includes nine counties in Minnesota and one county in South Dakota. The population in 1960 amounted to 162,000, a small decline from the 1950 level. As shown in *Table P-52*, population in this rural area is expected to decline further in the 1960's and then begin to increase, regaining the 1960 level in the 1980's and increasing to more than 200,000 by the year 2020.

(1) Population - In the 1950's, population declined slowly, at 0.1 percent annually, compared with increases of 1 to 2 percent annually in the national, multistate and Basin areas. In the 1960 decade, population is projected to decline by nearly 1 percent annually, compared with a 1.4 annual percent increase in the Basin and Nation. After 1970, the subregion's population is expected to increase at a rate between a 0.5 and 1 percent annually, well below the national, multistate and Basin growth rates. The slow growth in population projected for the subregion will be accompanied by emigration, especially of persons between 15 and 35 years old.

(2) Labor Force - The labor force is also expected to decline during the 1960's - at an annual rate of 1 percent. After 1970, however, the labor force is expected to increase, although at half the rate expected for the Nation, multistate and Basin areas. The proportion of persons in the labor force is very close to the national, multistate and Basin levels and this is not expected to change in the future. Men, partly as a result of the rural nature of the subregion, tend to have a greater attachment to the labor force, and women less attachment relative to the Nation, multistate, and Basin areas.

(3) Income - The agricultural base of the subregion is also reflected in personal income trends. Personal income per capita has been about two-thirds the level of the multistate region and a smaller proportion relative to the Basin. As the region loses agriculture and attracts higher wage industries, per capita income is projected to grow at a slightly faster pace than in the Nation, multistate or Basin areas. However, even by the year 2020, it is expected to be only about 80 percent of the multistate, national and Basin levels. Because of the slow growth in population and employment, total personal income in the region is expected to grow at a slower rate than in the Nation, multistate, and Basin areas.

(4) Employment - Civilian employment, after declining slightly in the 1950's, is expected to increase at a slow pace to 2020, but it is not likely to reach the rates of the Nation, multistate or Basin areas. By 2020, employment is projected to approach 70,000, about one-third above the 1960 level.

Employment in export industries, which tend to sell their product or services primarily outside the region, decreased in the 1950's and is expected to decline further in the future. Employment in residentiary industries--those that tend to serve the inhabitants of the region--also declined in the 1950-60 period; this trend is expected to reverse direction in the projected periods; increasing slowly in the early decades but picking up speed in the later decades. However, export employment, perhaps, because of relatively low wages is not expected to generate as much residentiary employment in the subregion as it does in the total Basin.

Agriculture is the region's major industry, employing nearly half the workers in the area in 1960. Although agricultural employment has declined from 1950 and is expected to continue this trend, it is expected to remain the second largest employer in 2020--losing its primary position to services by the turn of the century. Manufacturing employs a relatively small proportion of the region's workers and is expected to continue at this share. Food and kindred products is the major manufacturing industry, employing about three-fourths of the manufacturing workers. The food industry, while not expected to grow rapidly, is still projected to account for more than half the manufacturing activity in the area by the year 2000. Mining is a small proportion of the region's employment--less than 1 percent--and is expected to continue at this share.

Table P-52

Selected Summary Data,
Subregion 3 — Southwest Minnesota
(NPA Code 3, Map Code C)

	Unit	1950	1960	1970	1980	1990	2000	2010	2020
Population	thousands	165	163	148	153	167	174	192	209
Students	thousands	–	–	–	–	–	–	–	–
Total, excluding students	thousands	165	163	148	153	167	174	–	–
Male	thousands	85	82	73	75	81	85	–	–
Female	thousands	80	80	75	78	86	89	–	–
Total, 15–69 yrs. excl. students	thousands	106	96	90	92	96	103	–	–
Male	thousands	55	48	44	44	47	50	–	–
Female	thousands	51	47	46	47	50	53	–	–
Total, excluding rural farm	thousands	81	91	84	101	122	133	155	176
Labor Force:									
Total	thousands	–	59	54	55	58	62	–	–
Male	thousands	–	44	37	39	40	43	–	–
Female	thousands	–	15	16	17	17	19	–	–
Labor Force Participation Rate:									
Total	percent	–	60.1	59.5	60.5	59.9	60.4	–	–
Male	percent	–	88.0	84.7	87.1	86.2	86.5	–	–
Female	percent	–	31.7	35.2	35.4	35.1	35.5	–	–
Employment (jobs):									
Total	thousands	52	51	52	54	56	60	65	69
Export	thousands	30	30	29	28	26	25	–	–
Residentiary	thousands	22	22	23	26	30	35	–	–
Total Employment (persons)	thousands	–	–	49	51	53	57	–	–
Unemployment Rate	percent	2.2	5.0	8.1	8.0	8.0	8.0	–	–
Personal Income:									
Total	mil. 1960 $	236	248	328	447	618	883	1,277	1,774
Wages and salaries	mil. 1960 $	164	162	215	295	409	587	–	–
Other income	mil. 1960 $	72	86	112	152	209	297	–	–
Per capita	1960 $	1,430	1,524	2,219	2,924	3,707	5,074	6,660	8,508
Wages and salaries per employee	1960 $	3,122	3,170	4,158	5,509	7,337	9,775	–	–

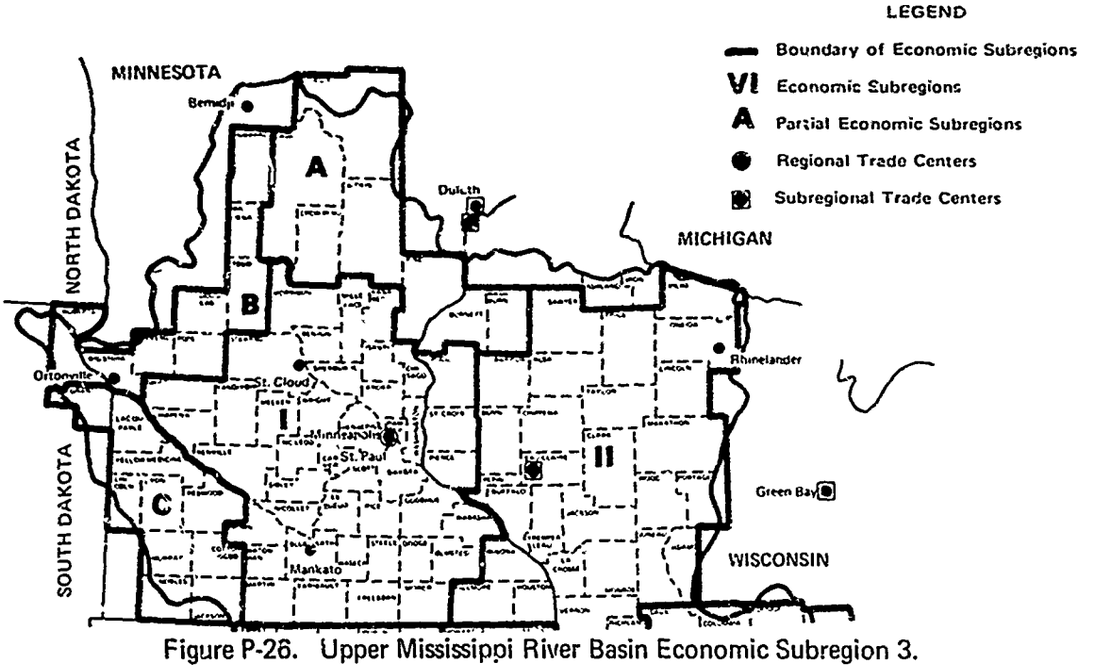

Figure P-26. Upper Mississippi River Basin Economic Subregion 3.

Among the noncommodity industries, retail trade is now the largest employer, with more than 10 percent of the total employment in 1960; it is expected to retain this share to the year 2020. Services and government, however are the fastest growing industries in the area. Both industries are expected to double employment between 1960 and 2020; services increasing from one-sixth to one-third of the workers, and government from about 5 to 10 percent of employment. Wholesale trade, construction, transportation, communications, public utilities, finance, insurance and real estate individually are small proportions of the region's employment and together account for about 15 percent of employment–a share not expected to change in 2020.

2.4.2 The Major Economic Subregions

The fact that population concentration, retail market area centers, and wholesale market area centers tend to coincide provides a basic justification for concluding that economic subregions can be delineated, which are approximately consistent with the following criteria:

(1) Boundaries should not divide or border concentrations of population and productive activity.*
(2) Each subregion should contain its own retail trade market areas.
(3) Each subregion should contain its own wholesale trade market areas.
(4) Each subregion should contain its own labor market areas.

Consistency among these criteria is based upon the assumption that the observed nodal characteristics of the geographical distribution of economic activity and population imply that the economic decisions of individuals are, in fact, significantly influenced by the material and time costs of overcoming distances, and that business firms are similarly influenced by the influence of transportation service cost (of both outputs and inputs) on the total cost of the product or service they are selling. If this assumption is correct, then a set of regions consistent with the second through the fourth criteria should also be consistent with the first criterion. The following economic profiles consist of a brief discussion of data and projections for each of the eight major economic subregions in the Basin. The format is consistent with the economic profiles by plan area included in Section 1. That is, the discussion centers on the variables of population, labor force, employment, and income.

2.4.2.1 Minneapolis-St. Paul Economic Subregion (NPA Code 4, Map Code I)

The Minneapolis-St. Paul subregion comprises 39 counties in the Southeastern part of Minnesota and three counties in the west-central portion of Wisconsin. Although many of these counties are predominantly rural, the metropolitan complex of Minneapolis and St. Paul dominates the area's economy. As shown in *Table P-53*, the population in this region was approaching two and one half million in 1960, and is expected to be nearly 5 million persons by the year 2000. The 6.6 million population projected for 2020 represents a 2.7-fold increase over the 1960 level and is second only to the Milwaukee subregion in terms of rate of population change over the 1960-2020 period.

(1) Population – In the 1950–60 decade, population increased by more than 300,000; this 1.8 percent annual increase was the same as in the Nation and higher than in the multistate and Basin areas. The growth was caused mostly by natural increase, immigration accounting for only one out of eight new persons in the area. During the 1960–80 period population is expected to increase at a faster rate than in the Nation, multistate or Basin areas, with immigration still accounting for a small proportion of the increase. Between 1980 and 2000, however, the migration flow is expected to reverse, so that the region's population growth is expected to slow down to approximately the rates for the Nation, multistate and Basin areas.
(2) Labor Force – Associated with the population increases, labor force is expected to increase somewhat faster than in the Nation, multistate and Basin areas between 1960 and 1990, but at a slower pace thereafter. Some of the relatively rapid labor force increase in the subregion is attributable to the relatively high labor participation of both men and women in the subregion.
(3) Income – Per capita personal income in the subregion has been slightly higher than in the Nation but lower than in the multistate and Basin areas and is expected to increase at annual rates close to those for the three areas throughout the projected period. The level of per capita income in the region, is not expected to reach the national or multistate level by 2020, although it passes the Basin level by the year 2010.

*This is not meant to imply that a continuum of densely populated areas may not exist on the border of a subregion See *Figure P-3.*

Table P-53
Selected Summary Data,
Subregion 4 – Minneapolis-St. Paul
(NPA Code 4, Map Code I)

	Unit	1950	1960	1970	1980	1990	2000	2010	2020
Population	thousands	2,027	2,439	2,973	3,646	4,230	4,801	5,585	6,588
Students	thousands	37	50	79	91	102	112	–	–
Total, excluding students	thousands	1,990	2,389	2,894	3,555	4,128	4,689	–	–
Male	thousands	981	1,166	1,410	1,745	2,034	2,318	–	–
Female	thousands	1,009	1,223	1,484	1,810	2,095	2,372	–	–
Total, 15–69 yrs. excl. students	thousands	1,336	1,436	1,723	2,112	2,453	2,823	–	–
Male	thousands	651	691	834	1,031	1,206	1,394	–	–
Female	thousands	685	745	890	1,080	1,248	1,428	–	–
Total, excluding rural farm	thousands	1,632	2,111	2,697	3,421	4,038	4,643	5,445	6,466
Labor Force:									
Total	thousands	–	947	1,109	1,349	1,581	1,834	–	–
Male	thousands	–	634	695	845	991	1,151	–	–
Female	thousands	–	313	414	504	590	683	–	–
Labor Force Participation Rate:									
Total	percent	–	62.3	64.4	63.9	64.5	65.3	–	–
Male	percent	–	85.6	83.5	82.1	82.4	83.1	–	–
Female	percent	–	40.1	46.5	46.6	47.3	48.0	–	–
Employment (jobs):									
Total	thousands	779	992	1,146	1,365	1,598	1,852	2,148	2,449
Export	thousands	335	410	463	518	569	644	–	–
Residentiary	thousands	443	582	683	847	1,029	1,208	–	–
Total Employment (persons)	thousands	–	–	1,066	1,297	1,518	1,759	–	–
Unemployment Rate	percent	3.3	4.1	3.9	3.9	4.0	4.1	–	–
Personal Income:									
Total	mil. 1960 $	3,798	5,452	8,778	13,787	20,848	31,139	46,749	68,869
Wages and salaries	mil. 1960 $	2,667	3,848	6,162	9,485	14,302	21,299	–	–
Other income	mil. 1960 $	1,132	1,603	2,616	4,302	6,546	9,840	–	–
Per capita	1960 $	1,874	2,235	2,953	3,781	4,928	6,486	8,371	10,454
Wages and salaries per employee	1960 $	3,424	3,880	5,378	6,949	8,949	11,501	–	–

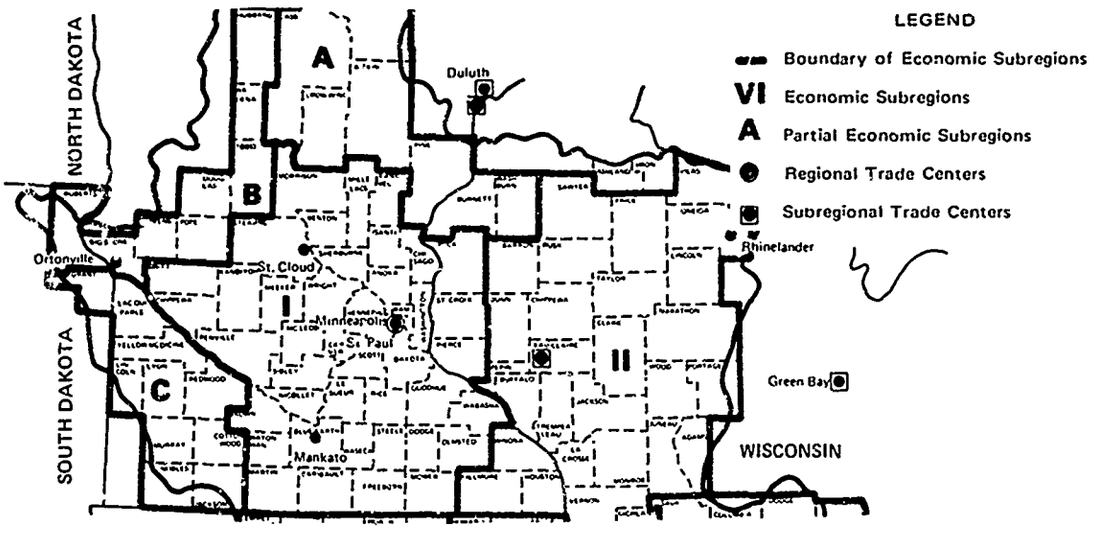

Figure P-27. Upper Mississippi River Basin Economic Subregion 4.

(4) Employment – Civilian employment in the subregion increased at nearly twice the nation, multistate and Basin area pace during the 1950–60 period, but is not expected to maintain this difference. The annual rate of employment increase in the region is expected to be about 1.6 percent, approaching 1.9 million jobs by the year 2000, compared with a million in 1960.

Industries exporting their goods or services from the area increased their employment in the 1950's and are expected to continue to grow, although at a slower pace. The number of workers in industries serving the area–residentiary–also grew more rapidly than in the total Basin, but is expected to increase at about the same rate as the Basin in the total 1960–2000 period. Export employment has generated more residentiary employment in the subregion than in the total Basin and is expected to continue this relationship through the end of this century.

Manufacturing, in 1950, represented the largest employer of the subregion's workers, and was a close second to services in 1960. By the year 2020 manufacturing is still expected to be the second largest employer, although it is projected to grow at a slower rate than total employment. The food and kindred products industry in 1960 was the largest manufacturing activity in the subregion but is expected to lose its primary place to electrical machinery and equipment manufacturers by 1990 and lose its second place to the nonelectric machinery and equipment manufacturers by the year 2000. The electric and nonelectric machinery manufacturers ranked fourth and second respectively, in 1960. Other large manufacturing industries in the region in 1960 were printing and publishing, instrument and related products, and fabricated metals manufacturing. The pulp and paper products industry also was a large employer in the subregion in 1960. The composition of the manufacturing sector, with the exceptions noted above, is expected to remain about the same by the turn of the century. Agriculture, which in 1950 employed more than 18 percent of the subregion's workers declined by one-third by 1960, to employ only one out of ten workers. By 2000, the industry is expected to lose another 40 percent of its workers and would employ less than 4 percent of the area's workers. Mining is expected to continue in a secondary role through the projected period, never to represent as much as 1 percent of the area's workers.

In the noncommodity sector, construction and wholesale trade are expected to grow at about the same rate of total employment in the subregion, individually not rising above 7 percent of the regional employment. Transportation, communications, and public utilities are expected to decline rapidly as a percent of total subregion employment while remaining constant in terms of the number employed. Retail trade is expected to decline slowly as a share of regional employment but may increase in absolute terms.

Services, finance, insurance and real estate, and government are expected to increase rapidly, both in absolute terms and in their share of employment; the latter two sectors will more than double their share of employment, while tripling and quadrupling in absolute terms by the year 2020.

2.4.2.2 Eau Claire Economic Subregion (NPA Code 5, Map Code II)

The Eau Claire subregion includes 26 counties in the Northwestern portion of Wisconsin and three counties in Eastern Minnesota.

(1) Population – The 1960 population of the subregion was 820,000, a small increase from the 1950 level. As shown in *Table P-54*, the population is expected to increase at a faster rate in the future, reaching, in the year 2020, over 1.8 million, 1 million more persons than in 1960. Annual increases of population in the subregion are projected to be at about the same rate as in the Nation, multistate, and Basin areas in the 1960–70 decade and at a somewhat faster rate in later decades. The population increases are expected to continue to be accompanied by emigration, although at a reduced rate from that experienced in earlier decades. Also a smaller portion of the emigrants is expected to be between 15 and 34 years of age than was the case in the 1950's.

(2) Labor Force – The labor force of the area is expected to increase at about the same pace as in the Nation, multistate and Basin areas. As in other highly rural areas, men are expected to continue to have a higher labor participation rate in the subregion than in both the Nation and the multistate area; women, even though showing a lower labor force participation than in the Nation, multistate and Basin areas, are not projected to increase their labor participation rate in the subregion, as employment opportunities are expected to be limited.

(3) Income – Personal income per capita is expected to increase at a more rapid rate than in the Nation, multistate, and Basin areas in the future, as it has in the past. Per capita income is expected to reach

Table P-54
Selected Summary Data, Subregion 5 — Eau Claire (NPA Code 5, Map Code II)

	Unit	1950	1960	1970	1980	1990	2000	2010	2020
Population	thousands	803	820	936	1,052	1,248	1,392	1,601	1,818
Students	thousands	6	9	22	30	34	33	–	–
Total, excluding students	thousands	797	811	914	1,022	1,214	1,354	–	–
Male	thousands	407	406	452	503	599	669	–	–
Female	thousands	262	241	273	301	346	393	–	–
Total, 15–69 yrs. excl. students	thousands	513	483	554	613	702	795	–	–
Male	thousands	390	405	463	519	615	685	–	–
Female	thousands	251	243	281	312	356	402	–	–
Total, excluding rural farm	thousands	510	594	743	892	1,106	1,267	1,493	1,726
Labor Force:									
Total	thousands	–	300	315	355	406	461	–	–
Male	thousands	–	212	220	248	284	322	–	–
Female	thousands	–	88	95	107	122	139	–	–
Labor Force Participation Rate:									
Total	percent	–	59.2	56.8	57.9	57.8	58.0	–	–
Male	percent	–	83.6	80.6	82.5	81.9	82.0	–	–
Female	percent	–	34.9	33.7	34.2	34.3	34.4	–	–
Employment (jobs):									
Total	thousands	277	273	315	358	410	464	534	604
Export	thousands	157	142	150	160	170	186	–	–
Residentiary	thousands	120	131	164	198	240	278	–	–
Total Employment (persons)	thousands	–	–	302	340	389	441	–	–
Unemployment Rate	percent	3.6	4.9	4.1	4.1	4.1	4.3	–	–
Personal Income:									
Total	mil. 1960 $	1,079	1,399	2,205	3,320	4,998	7,491	11,189	16,071
Wages and salaries	mil. 1960 $	764	953	1,502	2,238	3,373	5,071	–	–
Other income	mil. 1960 $	315	446	704	1,082	1,624	2,420	–	–
Per capita	1960 $	1,344	1,706	2,356	3,157	4,005	5,380	6,987	8,828
Wages and salaries per employee	1960 $	2,759	3,492	4,774	6,247	8,232	10,925	–	–

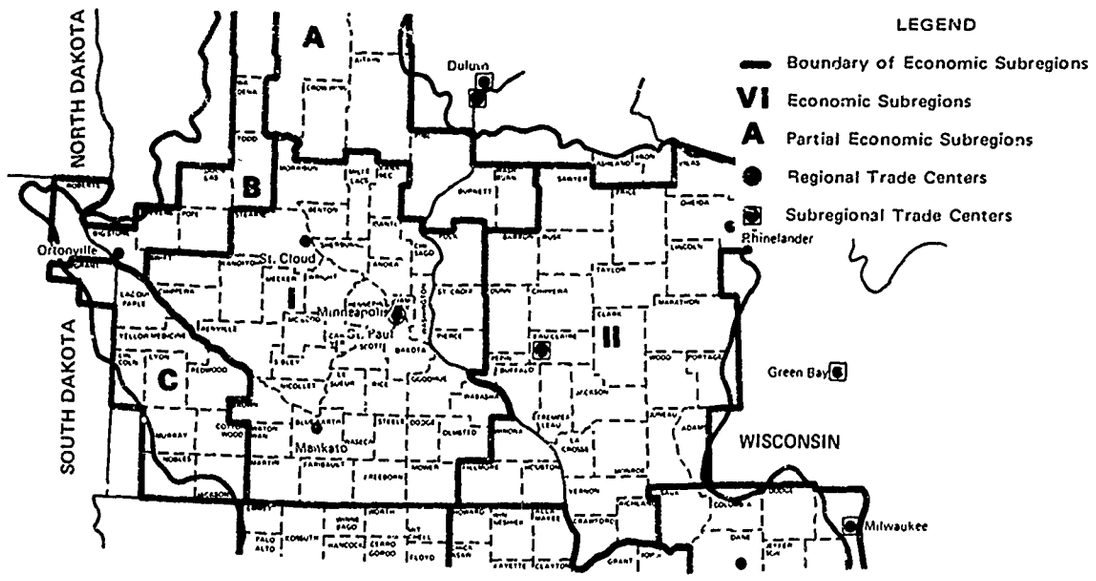

Figure P-28. Upper Mississippi River Basin Economic Subregion 5.

over $8,800 by the year 2020, when it will be about 85 percent of the multistate level, increasing from $1,700 or 75 percent of the multistate level in 1960. Total personal income is expected to increase at approximately the same rates as the totals for the Nation, multistate, and Basin areas after 1970.

(4) Employment – Civilian employment in the subregion declined slightly in the 1950's but is expected to reverse this trend in the projected period, increasing within a range of 1.2 to 1.4 percent per year between 1960 and 2020; this is at a slightly lower pace than the rate of employment change in the Basin area and Nation.

Employment in export industries–those selling primarily outside the subregion–is expected to increase at a slower rate than export employment in the total Basin area and also slower than residentiary employment within the subregion. Thus, although the decline in the export industries' share of subregional employment is expected to continue, it will generate rising personal incomes and more demand for goods and services within the subregion itself.

Agriculture, including forestry and fisheries, is the major employer in the subregion, accounting for one of every four workers in 1960, a drop from its share of 40 percent in 1950. By 1990, however, the industry is expected to lose its primary rank to both services and manufacturing, and by the year 2020, is projected to represent only 6 percent of the subregion's workers, the sixth ranking industry in the area.

Manufacturing is expected to be the second largest employer in the subregion by 1970, and is expected to hold that position in future decades. Pulp and paper products was the largest of the manufacturing industries in 1960, but it is expected to decline in the 1960–70 period, losing its rank to both food and kindred products and nonelectric machinery manufacturing by 1970. At the turn of the century, rubber and plastic products manufacturing, which increased rapidly in the 1950's and is expected to continue this rise, looms as the largest manufacturing employer in the subregion, followed by nonelectric machinery, pulp and paper products, which increases again after 1970, and food products which is not expected to increase in the projected period. Mining represents a small share of employment in the subregion and is not expected to change in the projected decades.

Of the noncommodity industries, services and government account for the major growth in employment during the projected period: services becoming the largest single employer in 1970. Finance, insurance and real estate is also expected to increase rapidly, more than tripling its 2.5 percent share of 1960 employment by the year 2020. Wholesale and retail trade and construction are expected to maintain a steady share of regional employment and transportation-communications and public utilities a declining share, although all are expected to increase employment in absolute terms.

2.4.2.3 Des Moines-Fort Dodge Economic Subregion (NPA Code 6, Map Code III)

The Des Moines-Ft. Dodge subregion includes 53 counties situated in the farmlands of central Iowa, six of which are not located in any of the Basin plan areas.

(1) Population – The 1960 population was about 1.4 million; it is expected to increase to more than 2.4 million by the end of the century and approach 3.3 million by the year 2020. In the 1950–60 period, the population rose very slightly. In the projected decades the approximate 1.5 percent annual rate of population growth is expected to be about the same as the multistate area and somewhat less than the rates for the Nation and Basin area. The slow growth of the 1950's was accompanied by substantial emigration–more than one-tenth of the 1950 population. Net emigration is expected to stop virtually in the 1960's and then to be reversed in the 1970–80 period. After 1980, emigrants are again expected to outnumber people moving into the subregion, although a smaller proportion of the emigrants are expected to be between the ages of 15 and 34 than in the 1950's, when this age group represented half the migrants.

(2) Labor Force – The labor force is expected to increase by some 60 percent between 1960 and 2000, less than the national, multistate and total Basin changes in the same period. The percent of population in the labor force follows the same pattern exhibited by other agricultural areas, a relatively high proportion of men and low proportion of women being in the labor force. These relative labor participation rates are expected to continue to the turn of the century.

(3) Personal Income – Personal income per capita is expected to increase at about the same rate as in the Nation and multistate area, although faster than in the total Basin area. As higher wage industries replace agriculture in the subregion, per capita income is expected to move close to the national,

Table P-55

Selected Summary Data,
Subregion 6 – Des Moines-Ft. Dodge
(NPA Code 6, Map Code III)

	Unit	1950	1960	1970	1980	1990	2000	2010	2020
Population	thousands	1,336	1,389	1,594	1,840	2,151	2,448	2,852	3,272
Students	thousands	19	21	41	54	61	69	–	–
Total, excluding students	thousands	1,317	1,368	1,553	1,786	2,090	2,379	–	–
Male	thousands	655	669	754	874	1,028	1,174	–	–
Female	thousands	663	699	799	913	1,062	1,206	–	–
Total, 15–69 yrs. excl. students	thousands	870	831	952	1,100	1,257	1,437	–	–
Male	thousands	429	402	402	538	619	710	–	–
Female	thousands	441	429	490	562	638	726	–	–
Total, excluding rural farm	thousands	933	1,052	1,298	1,580	1,928	2,256	2,672	3,105
Labor Force:									
Total	thousands	–	526	563	648	747	857	–	–
Male	thousands	–	369	393	452	522	600	–	–
Female	thousands	–	158	170	196	225	257	–	–
Labor Force Participation Rate:									
Total	percent	–	60.3	59.1	58.9	59.5	59.7	–	–
Male	percent	–	86.4	85.1	84.2	84.4	84.5	–	–
Female	percent	–	35.3	34.6	34.8	35.3	35.4	–	–
Employment (jobs):									
Total	thousands	492	490	559	656	755	863	1,001	1,148
Export	thousands	232	227	250	272	293	318	–	–
Residentiary	thousands	260	264	319	384	462	546	–	–
Total Employment (persons)	thousands	–	–	541	623	717	820	–	–
Unemployment Rate	percent	1.8	3.2	3.9	3.8	4.0	4.3	–	–
Personal Income:									
Total	mil. 1960 $	2,377	2,855	4,480	6,696	9,914	14,672	21,862	31,243
Wages and salaries	mil. 1960 $	1,727	1,903	2,984	4,466	6,622	9,830	–	–
Other income	mil. 1960 $	650	953	1,496	2,230	3,291	4,842	–	–
Per capita	1960 $	1,780	2,055	2,810	3,639	4,609	5,992	7,666	9,550
Wages and salaries per employee	1960 $	3,511	3,880	5,241	6,808	8,769	11,385	–	–

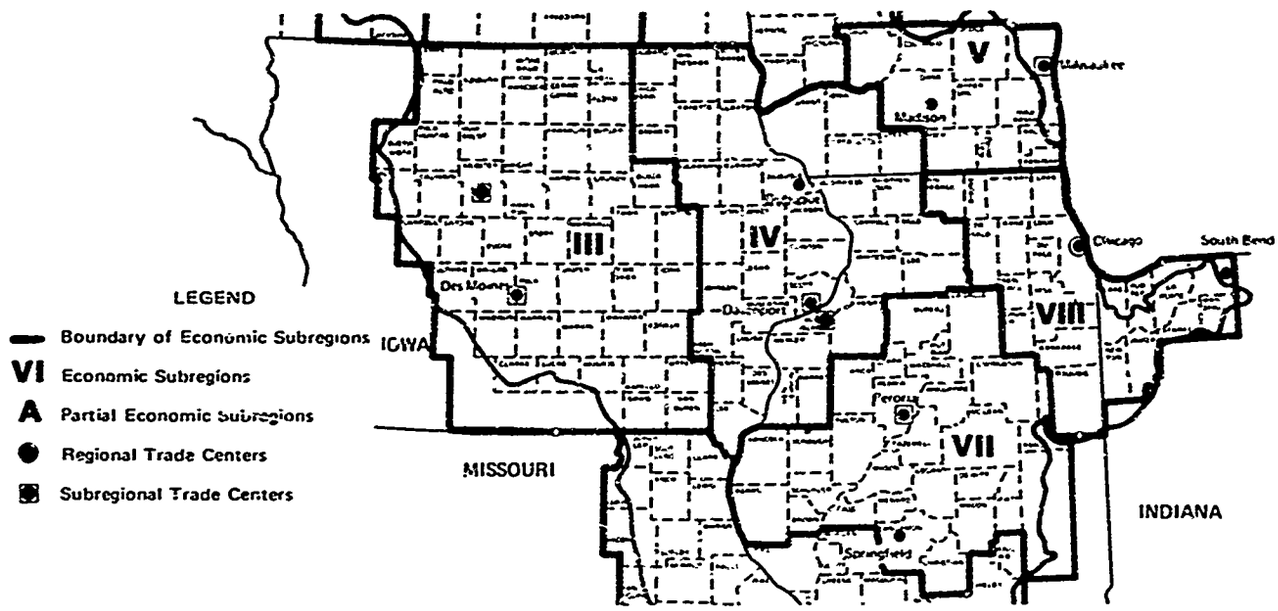

Figure P-29. Upper Mississippi River Basin Economic Subregion 6.

multistate and Basin levels by the year 2020. Total personal income is expected to rise at about the same rate as in the multistate and Basin areas, and somewhat less than in the Nation between 1960 and 2020.

(4) Employment - As shown in *Table P-55*, civilian employment in the subregion is expected to reverse its decline of the 1950–60 period, more than doubling, from 490 thousand to 1.1 million, between 1960–2020. This is about the same rate of growth as in the multistate but slower than in the Nation or Basin areas.

Employment in industries exporting their goods or services from the area decreased in the 1950's, but is expected to reverse this trend in future decades. Residentiary employment is expected to increase at about twice the rate of export employment in the subregion between 1960 and 2000, about the same relationship as in the total Basin. By the turn of the century it is expected that there will be nearly two residentiary industry employees for every export industry worker, a rise from the one to one ratio in 1950 and 1960.

Agriculture in 1950 was the largest employer of the subregion, engaging 60 percent more workers than its nearest rival, services. In the 1950–60 period, agriculture declined by one-fifth, bringing it to a level of employment about the same as services. Agriculture is projected to decline further, while the other industries are increasing, so that by 1970 it is expected to rank second in employment, fifth by the year 2000, and sixth by the year 2020; decreasing from employing nearly one-third to one-twentieth of the subregion's workers between 1950 to 2020.

Manufacturing is expected to retain about one-seventh of the subregion's workers through the projected period. In the 1950–60 period, manufacturers of nonelectric machinery replaced the food manufacturing industry as the major manufacturing employer. Electrical equipment, the third largest manufacturing employer, experienced a rapid increase in the 1950's, and by 1980 this is expected to be the largest manufacturing industry in the area. Electronics manufacturers in the Des Moines metropolitan area account for much of this employment. The one other industry employing a large and growing portion of manufacturing workers is the fabricated metals industry. Mining employs few workers in the subregion and is not expected to gain employment through the years. Retail trade employed about one-seventh of the total workers in the subregion in 1960, and although the industry is expected to double its employment between 1960 and 2020, its share of regional employment declines slightly. Services employment is expected to increase its 1960 level three and half times by the year 2020, rising from 22 to 38 percent of total employment. Government, which is expected to increase by a factor of 6 during this interval, rises from 4 to 11 percent of total employment.

Finance, insurance, and real estate is also expected to increase its share of the subregion's employment in the projected period, more than tripling its 1960 employment by 2020. Construction is expected to double in the same period, about the same growth as for total employment. Wholesale trade and transportation-communications-public utilities are projected to grow slowly, the latter group having about the same amount of employees in 2020 as in 1960. Both sectors are expected to decline as a share of employment during the projected period.

2.4.2.4 Davenport-Rock Island-Moline Economic Subregion (NPA Code 7, Map Code IV)

The Davenport-Rock Island-Moline subregion, straddling the Mississippi River, includes 23 counties in eastern Iowa, four counties in Southwest Wisconsin, and 11 counties in Northwest Illinois. In addition to the Davenport-Rock Island-Moline metropolitan area, the subregion contains two other metropolitan areas, Cedar Rapids and Dubuque, Iowa.

(1) Population – The regional population in 1960 was over 1.4 million persons, 10 percent above the 1950 level. As shown in *Table P-56*, the population is projected to continue rising, passing 2.5 million at the turn of the century and approaching 4 million by the year 2020. The population growth in the 1960's is projected at about 1 percent annually, less than that for the Nation, multistate, or total Basin areas. Between 1970 and 2000, population in the subregion is expected to grow at about the same rate as the Nation and Basin area and faster than the multistate area. In spite of the population growth in the 1950–60 period, the area showed a net emigration. Between 1960 and 1970 the area is expected to show a net emigration, although between 1970–90 net immigration should occur. In both the emigration and immigration periods, 15 to 34 year-old persons represent about half the migrants.

(2) Labor Force – The subregion's labor force is expected to grow along with the population, increasing at about the same rate as in the Nation, slightly faster than in the multistate area, but slower than in the

Table P-56

Selected Summary Data,
Subregion 7 — Davenport-Rock Island-Moline
(NPA Code 7, Map Code IV)

	Unit	*1950*	*1960*	*1970*	*1980*	*1990*	*2000*	*2010*	*2020*
Population	thousands	1,302	1,432	1,573	1,844	2,193	2,552	3,062	3,669
Students	thousands	20	25	43	58	63	67	–	–
Total, excluding students	thousands	1,282	1,407	1,530	1,786	2,130	2,485	–	–
Male	thousands	640	693	743	874	1,048	1,225	–	–
Female	thousands	642	714	787	912	1,082	1,260	–	–
Total, 15–69 yrs. excl. students	thousands	849	853	923	1,088	1,264	1,475	–	–
Male	thousands	422	417	447	530	621	726	–	–
Female	thousands	427	435	476	557	643	749	–	–
Total, excluding rural farm	thousands	965	1,136	1,310	1,614	1,993	2,382	2,904	3,523
Labor Force:									
Total	thousands	–	553	594	692	804	943	–	–
Male	thousands	–	382	385	442	521	611	–	–
Female	thousands	–	171	209	240	283	333	–	–
Labor Force Participation Rate:									
Total	percent	–	61.5	64.3	62.7	63.4	64.0	–	–
Male	percent	–	85.2	86.1	83.3	84.0	84.2	–	–
Female	percent	–	37.5	43.9	43.0	44.0	44.4	–	–
Employment (jobs):									
Total	thousands	482	522	595	694	818	948	1,137	1,344
Export	thousands	249	267	278	294	315	338	–	–
Residentiary	thousands	233	255	317	400	503	609	–	–
Total Employment (persons)	thousands	–	–	565	659	777	900	–	–
Unemployment Rate	percent	2.2	3.4	4.8	3.3	3.4	4.6	–	–
Personal Income:									
Total	mil. 1960 $	2,310	2,972	4,597	7,028	10,696	16,172	24,787	37,071
Wages and salaries	mil. 1960 $	1,660	2,022	3,135	4,723	7,209	10,900	–	–
Other income	mil. 1960 $	650	950	1,462	2,305	3,487	5,272	–	–
Per capita	1960 $	1,775	2,075	2,921	3,811	4,877	6,337	8,096	10,103
Wages and salaries per employee	1960 $	3,446	3,871	5,268	6,808	8,814	11,500	–	–

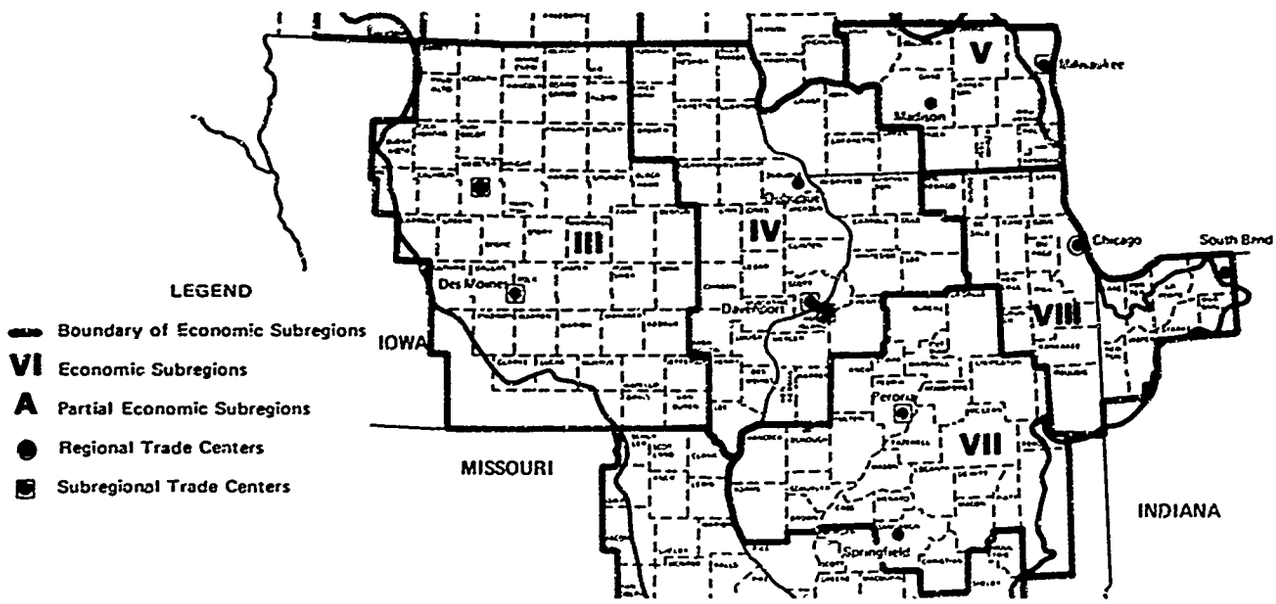

Figure P-30. Upper Mississippi River Basin Economic Subregion 7.

total Basin between 1960 2000. The labor participation rate in 1960 was higher in the subregion than in the Nation, multistate, and Basin areas, and it is expected to remain consistently higher in the projected period.

(3) Personal Income Personal income per capita has been and is expected to continue to be lower than the levels for the Nation, multistate, and Basin areas, but in future decades it is projected, however, to grow somewhat faster than in the multistate and Basin areas, and at about the same pace as the national rate. Total personal income is expected to grow at about the same rate as in three other areas in the 1960–70 period and at a faster pace than that of the other areas between 1970–2020.

(4) Employment Civilian employment which increased at less than 1 percent annually in the 1950–60 period is expected to increase at 1.7 percent annually in the future. In the 1960's the subregion's employment is expected to grow at the same rate as the Basin, faster than the multistate, and slower than the national rate; subsequent to 1980, the subregion's employment is expected to grow more rapidly than in the other three areas. By 2020 the subregion's employment is projected at 1.3 millio r jobs, two and a half times the 1960 level.

Employment in export industries those selling primarily outside the subregion–is expected to grow more slowly than total employment. While in 1950 and 1960 there were less residentiary industry employees than in the export industries, by the turn of the century the residentiary industries are likely to employ 80 percent more workers than the export industries.

Agriculture, which was previously the largest industry in the subregion, lost its primary position to both manufacturing and services by 1960. By the year 2020, agriculture is expected to decline to half its 1960 level, reducing its share of employment from one-fourth in 1950 to one-twenty-fifth by 2020.

In 1960 manufacturing industries accounted for more employment than any other sector in the subregion. In the 1950 60 decade, manufacturing in the subregion showed a 50 percent faster growth than in the Nation and over three times the growth in the multistate and Basin areas. Employment in manufacturing is expected to increase in future decades, but at a much slower rate than in the 1950's.

The two largest manufacturing industries of the area are food and kindred products and nonelectric machinery and equipment: both are industries with low growth potential. The food industry is expected to remain stable, hardly increasing its employment while the nonelectric machinery industry is projected to employ fewer persons by the turn of the century than it does now. The electrical machinery and equipment industry is expected to almost triple its employment from 1960 to 2000, accounting for most of the growth in the manufacturing sector and surpassing the nonelectric equipment industry in size of employment by 1990. Fabricated metals manufacturers also employ a relatively large number of the subregion's workers, but they are not expected to increase their employment in the future. Mining activity employs few of the subregion's workers and is expected to continue to do so in the projected period.

In the noncommodity sector, services are expected to increase by a factor of 6 between 1960 and 2020 becoming the largest single employer by 1980. Government employment in 2020 is expected to be over five times its 1960 level. Finance, insurance and real estate is the only other industry expected to substantially increase its employment in the projected period, more than doubling its share by 2020.

The other noncommodity industries all are projected to increase their employment; wholesale trade and construction are expected to maintain their share of the subregion's employment while retail trade and transportation, communications, and public utilities are expected to lose in their share.

2.4.2.5 Milwaukee Economic Subregion (NPA Code 8, Map Code V)

The Milwaukee subregion is located in the southeastern section of Wisconsin, on the shores of Lake Michigan. It includes 13 counties, half of which are parts of metropolitan areas and 20 of which are not in the Basin plan areas. Three metropolitan areas, in addition to Milwaukee, are within the subregion. Madison, Kenosha, and Racine.

(1) Population As shown in *Table P-57*, the subregion's population in 1960 totalled more than 2 million and is expected to double by the turn of the century with the addition of another 2 million by 2020 when it approximates 6 million people. The rate of population growth in the 1950's exceeded the rate for the Nation and substantially exceeded the growth in the multistate and Basin areas. Population is expected to grow faster in the subregion than in the other areas between 1960–90, but after 1990 the regional rate of growth about equals those for the other areas. This region is expected to be the fastest growing of the 11 subregions in the Basin area. Substantial immigration accounted for some of the

Table P-57
Selected Summary Data,
Subregion 8 – Milwaukee
(NPA Code 8, Map Code V)

	Unit	1950	1960	1970	1980	1990	2000	2010	2020
Population	thousands	1,676	2,096	2,580	3,162	3,789	4,384	15,218	6,069
Students	thousands	30	45	69	77	79	84	–	–
Total, excluding students	thousands	1,646	2,051	2,511	3,085	3,710	4,300	–	–
Male	thousands	812	1,008	1,229	1,517	1,831	2,130	–	–
Female	thousands	834	1,043	1,282	1,568	1,879	2,170	–	–
Total, 15–69 yrs. excl. students	thousands	1,145	1,272	1,513	1,846	2,224	2,618	–	–
Male	thousands	561	618	737	903	1,100	1,296	–	–
Female	thousands	584	654	776	943	1,134	1,322	–	–
Total, excluding rural farm	thousands	1,519	1,980	2,482	3,081	3,721	4,330	5,169	6,025
Labor Force:									
Total	thousands	–	832	999	1,187	1,410	1,634	–	–
Male	thousands	–	570	631	749	897	1,047	–	–
Female	thousands	–	263	368	438	513	587	–	–
Labor Force Participation Rate:									
Total	percent	–	61.8	66.2	64.4	63.2	62.5	–	–
Male	percent	–	86.0	86.0	83.3	81.8	81.0	–	–
Female	percent	–	38.4	47.5	46.5	45.2	44.4	–	–
Employment (jobs):									
Total	thousands	719	878	1,049	1,220	1,414	1,619	1,891	2,160
Export	thousands	363	402	446	504	562	626	–	–
Residentiary	thousands	356	476	603	716	852	993	–	–
Total Employment (persons)	thousands	–	–	975	1,160	1,343	1,538	–	–
Unemployment Rate	percent	2.3	3.6	2.4	2.3	4.8	5.9	–	–
Personal Income:									
Total	mil. 1960 $	3,666	5,248	8,362	12,574	18,649	27,449	41,348	59,382
Wages and salaries	mil. 1960 $	2,675	3,774	5,937	8,738	12,775	18,802	–	–
Other income	mil. 1960 $	992	1,474	2,425	3,835	5,874	8,646	–	–
Per capita	1960 $	2,188	2,504	3,241	3,977	4,922	6,261	7,924	9,784
Wages and salaries per employee	1960 $	3,720	4,301	5,661	7,160	9,037	11,615	–	–

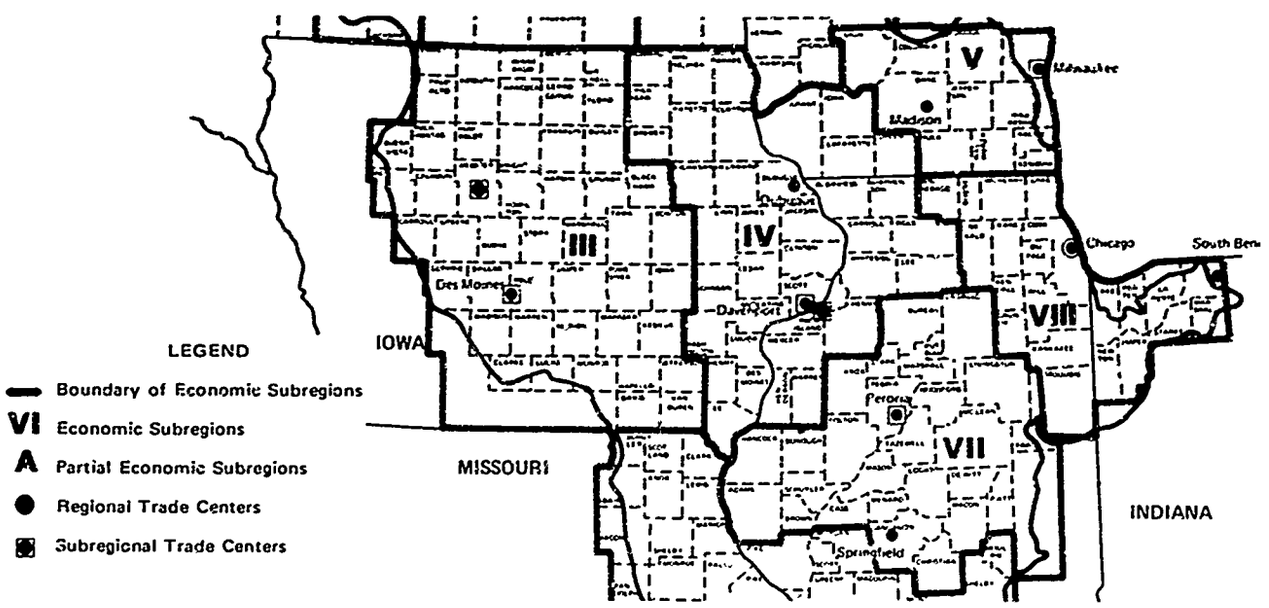

Figure P-31. Upper Mississippi River Basin Economic Subregion 8.

population growth in the 1950's. Half the immigrants were in the 25–34 age group in the decade. Immigration is expected to continue to 1990, at which a time a stabilization and subsequent reverse trend is expected to occur.

(2) The Labor Force – The labor force is expected to increase rapidly to the turn of the century. As for population, the subregion is among the leaders in expected labor force growth, almost doubling between 1960 and 2000. The annual rates of growth of the subregion's labor force is expected to be higher than in the Nation, multistate and Basin areas between 1960 and 1990, and slower than the Nation, but at the same pace as the multistate and Basin areas after 1990. The participation of the population in the labor force has been higher than the rate in the Nation, multistate, and Basin areas, and is expected to remain higher, even though it declines after 1970. Both men and women have higher labor participation rates than in the Nation, multistate, and Basin areas.

(3) Income – Personal income per capita, in 1960, was $2,500, nearly 10 percent higher than the level for the multistate area, and close to 5 percent higher than the national level. These relationships, however, are not expected to continue. After 1970, the subregion's per capita income grows at a relatively slow pace, and by 1980 its projected level of about $4,000 falls below the national and multistate levels. This occurs partly because of a shift in employment towards low wage industries. Total personal income in the subregion, on the other hand, is expected to grow at about the same rate as in the three areas due to the relatively rapid increase of the subregion's population.

(4) Employment – Civilian employment in the subregion is expected to continue increasing, but not as rapidly as the 1950–60 annual rate of more than 2 percent. The projected annual rate of increase is close to that expected for the Nation but higher than rates expected in the total Basin and multistate areas. The subregion's employment in 1960 was approaching the 900,000 mark, over one-fifth higher than its position 10 years before. By the turn of the century it is expected to pass 1.6 million and by 2020 to approach 2.2 million. The expected average rate of growth in the subregion is more than those of the multistate and Basin areas, but lower than the national rates between 1960 and 2020.

Employment in industries exporting their goods or services from the subregion has increased at a faster rate than in the total Basin and is projected to continue that trend. Residentiary employment is also expected to increase–about half again as fast as export employment. In 1960, six workers were engaged in residentiary industries for every five export industry workers; the ratio at the turn of the century is expected to be eight to five, due to increasing incomes of persons in the subregion and the rising demand for services from both the public and private sectors.

Agriculture employed less than five percent of the subregion's employment in 1960 and is expected to lose employment at a slow rate in the future. Mining is expected to increase its employment gradually but will continue to have a small share of the subregion's employment. Manufacturing is by far the largest industry of the subregion, accounting for more than one-third of the employment in 1960. While increasing slightly in the 1950's, manufacturing decreased as a proportion of the subregion's employment by about 6 percentage points. Employment is expected to continue to rise in the future, even at a more rapid pace than in the 1950–60 period; however, it will continue to decline as a share of civilian employment, accounting for less than a quarter of employment in the year 2020.

Nonelectric machinery, electric machinery, and transportation equipment are the three largest manufacturing industries, together employing half the manufacturing workers in 1960. The electric and transportation equipment employment is projected to increase, while nonelectric equipment is expected to decline, all continuing their 1950–60 trends. Both electric and transportation equipment are expected to employ more workers than nonelectric equipment by 1980. Food and kindred products and printing and publishing are the two largest nondurable manufacturing sectors. In both, employment is not expected to change and thus decline as a portion of total employment.

Services is currently the largest noncommodity industry and is expected to become a larger employer than manufacturing by 1990. The industry is expected to grow to four and a half times its 1960 size by the year 2020, employing more than one-third of the subregion's workers in that year, as compared to one-fifth in 1960. Trade is the second largest noncommodity industry in the subregion, but it is expected to grow at a slightly slower rate than the subregion's total employment. Government, finance, insurance and real estate, and construction are expected to increase rapidly in number of employees and as shares of regional employment. Government is expected to be the most rapidly growing employer. Transportation, communications, and public utilities are expected to increase in their employment slowly, while declining in their relation to total regional employment.

2.4.2.6 Chicago Economic Subregion (NPA Code 9, Map Code VIII)

The Chicago subregion includes 13 counties in the northeastern part of Illinois and eight counties in the northwestern section of Indiana, one of which is outside the Basin plan areas. Included in the subregion is the Gary-Hammond-East Chicago, Indiana metropolitan area (part of the Chicago consolidated area) which, combined with the Chicago metropolitan area, constitutes the third largest population complex in the Nation.

(1) Population – The subregion has over one-third of the Basin's total population. As shown in *Table P-58*, the population in 1960 was nearing 7.7 million, and by the turn of the century is expected to pass 14 million, approaching 20 million by the year 2020. The projected increase of more than 1.5 percent annually is about the same as the national and total Basin increases but larger than that expected for the multistate area. The 1950–60 growth in population was about 2 percent per year. This growth was accompanied by a net immigration amounting to 7 percent of the 1950 population. Most of the migrants were in their prime working ages, 25 to 34. From 1960 to 1990 the immigration is expected to continue, but at a reduced pace. Also, about half the migrants are expected to be between 25 and 34 years old.

(2) Labor Force – the changes in labor force reflect the population trends. At the turn of the century, the subregion is expected to have 5.5 million persons in its labor force, almost double the 1960 level of 3.2 million. In comparison, growth in the subregion is projected to be slower than the Nation, faster than in the multistate area, and about the same as the total Basin area between 1960 and 2000. Both men and women have a higher labor participation rate than in the Nation, multistate, or Basin areas. The subregion's labor participation rate is projected to decrease slightly after 1970, reaching the same level as projected for the entire Basin by the turn of the century.

(3) Income – The subregion's personal income per capita was $2,900 in 1960, 25 percent above the national level. However, the subregion's per capita income is not expected to grow as fast as in the Nation and multistate areas. Thus, the level of $10,800 which it is expected to reach by the year 2020 is only slightly higher than in these other areas.

(4) Employment – Civilian employment totalled 3.3 million in 1960 and is expected to pass 5.5 million at the turn of the century. The subregion employment, growing faster than that of the Nation, multistate, and Basin areas in the past, is expected to grow more slowly in the future, as surrounding areas improve their capability to attract new job opportunities. However, even by the year 2020, the subregion is expected to have more than one-third of the River Basin's employees.

The subregion's export employment rapidly grew in the 1950–60 decade; however, this growth is projected to slow down. Residentiary employment in the subregion, as in other areas, has increased more rapidly than export employment and is expected to continue adding to its lead. The ratio of export to residentiary employment in the subregion is projected to be about the same as in the Basin as a whole, rising from 1.1 employees for every export worker in 1950 to 1.7 to 1 by the turn of the century.

Agriculture and mining employment represent small shares of the subregion's employment, less than 2 percent in 1960, and less than 1 percent by 2000. Both industries are expected to continue to employ fewer workers as the years progress. Manufacturing, employing more than 1 million workers in 1960 is the largest employer in the subregion. The Chicago subregion has accounted for half the Basin's manufacturing employment, one-third the multistate area's manufacturing, and about 7 percent of national employment in manufacturing. However, partly because of a general tendency for manufacturing to become more widespread geographically, a relatively slow growth has been projected in the subregion's manufacturing so that by the year 2020 it is expected to account for 32 percent of the multistate manufacturing and 5 percent of the national manufacturing employment. Manufacturing is expected to decline from one-third of employment in 1960 to one-fourth by the turn of the century.

In 1960 each of five manufacturing industries provided over 100,000 jobs to total more than half the manufacturing in the subregion. The largest of these industries - electrical machinery and equipment manufacturing – is expected to grow more rapidly than the rest of manufacturing, approaching 220,000 employees by the turn of the century.

The manufacturing of fabricated metals, currently the second largest manufacturing industry, and also projected to increase more rapidly than total manufacturing employment, is expected to reach 200,000 employees by the year 2000. The nonelectrical machinery and equipment industry, the third largest sector in 1960, is expected to lose employment in the future, as it did in the 1950–60 decade, declining to 120,000 employees by the year 2000. Primary metals manufacturing is projected to show

Table P-58
Selected Summary Data,
Subregion 9 – Chicago
(NPA Code 9, Map Code VIII)

	Unit	1950	1960	1970	1980	1990	2000	2010	2020
Population	thousands	6,288	7,656	8,774	10,467	12,370	14,290	16,722	19,601
Students	thousands	51	59	89	115	130	159	–	–
Total, excluding students	thousands	6,237	7,597	8,685	10,352	12,240	14,141	–	–
Male	thousands	3,083	3,733	4,246	5,062	6,032	6,994	–	–
Female	thousands	3,154	3,865	4,439	5,271	6,208	7,147	–	–
Total, 15–69 yrs. excl. students	thousands	4,490	4,893	5,585	6,593	7,626	8,881	–	–
Male	thousands	2,210	2,387	2,722	3,226	3,758	4,393	–	–
Female	thousands	2,280	2,506	2,863	3,367	3,868	4,488	–	–
Total, excluding rural farm	thousands	6,155	7,530	8,072	10,390	12,304	14,236	16,673	19,557
Labor Force:									
Total	thousands	–	3,183	3,584	4,181	4,811	5,540	–	–
Male	thousands	–	2,129	2,311	2,697	3,105	3,580	–	–
Female	thousands	–	1,054	1,272	1,484	1,706	1,960	–	–
Labor Force Participation Rate:									
Total	percent	–	63.0	64.4	63.6	63.3	62.5	–	–
Male	percent	–	86.0	85.7	84.2	83.1	81.9	–	–
Female	percent	–	40.8	44.5	44.1	44.1	43.7	–	–
Employment (jobs):									
Total	thousands	2,790	3,330	3,728	4,243	4,878	5,593	6,502	7,411
Export	thousands	1,310	1,551	1,639	1,754	1,897	2,057	–	–
Residentiary	thousands	1,480	1,779	2,089	2,489	2,981	3,537	–	–
Total Employment (persons)	thousands	–	–	3,467	4,031	4,634	5,313	–	–
Unemployment Rate	percent	4.0	4.2	3.3	3.6	3.7	4.1	–	–
Personal Income:									
Total	mil. 1960 $	16,072	22,233	34,176	48,929	70,086	101,411	147,308	211,157
Wages and salaries	mil. 1960 $	11,642	16,089	24,436	34,250	48,009	69,466	–	–
Other income	mil. 1960 $	4,429	6,144	9,740	14,679	22,077	31,944	–	–
Per capita	1960 $	2,556	2,964	3,895	4,674	5,666	7,097	8,809	10,773
Wages and salaries per employee	1960 $	4,172	4,831	6,555	8,072	9,843	12,420	–	–

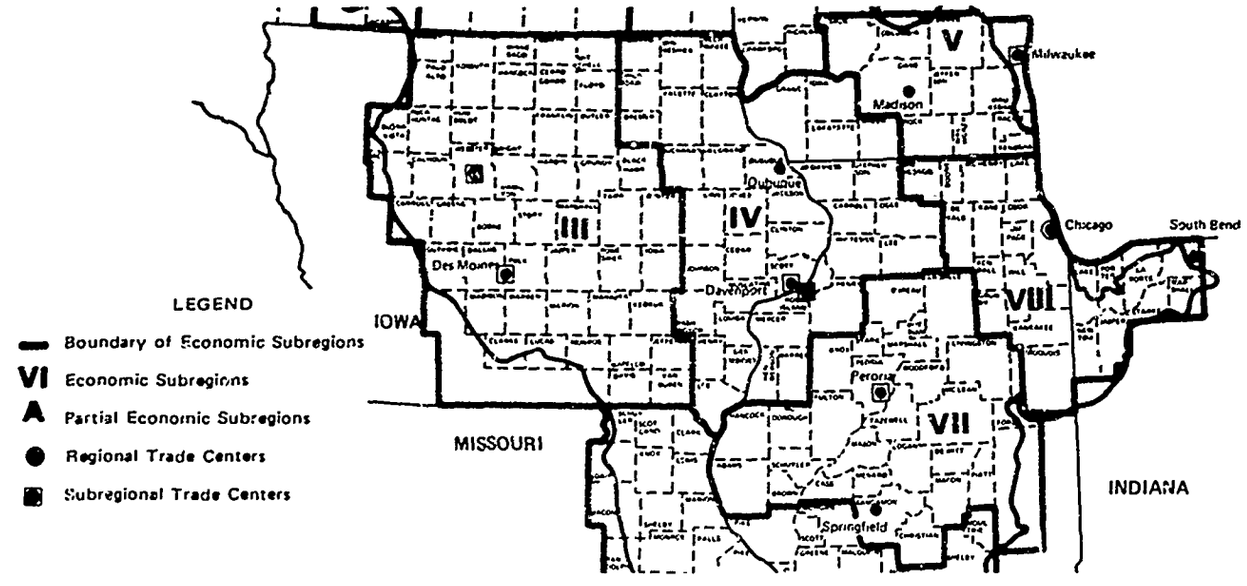

Figure P-32. Upper Mississippi River Basin Economic Subregion 9.

little change of employment through the years, while food and kindred products fall below their 1950 level of employment by the year 2000, reaching a level of 105,000 employees. Printing and publishing, which had just below 100,000 employees in 1960, is expected to pass 110,000 employees by the turn of the century. Other important manufacturing industries in the subregion are transportation equipment, chemicals, apparel, and instruments. Of these, instruments manufacturing is expected to grow rapidly, while chemicals and transportation equipment grow slowly, and apparel declines relatively rapidly.

Among the noncommodity sectors, services represent the major employer, increasing by nearly 40 percent in the 1950–60 decade. By 1990 the industry is expected to be the largest employer in the subregion, accounting for almost 1.5 million jobs and, by the year 2020, being three times its 1960 level. Finance, insurance and real estate and government are also expected to grow rapidly, rising from one-tenth of the subregion's workers in 1960 to 16 percent by 2020 and are expected to be between two and three times their 1960 level by the year 2020. These two sectors are expected to employ over 1 million workers.

Retail and wholesale trade are also expected to increase in employment, but not as rapidly as overall regional employment. Construction is expected to grow at a more rapid pace than overall regional employment, almost tripling its jobs by 2020.

2.4.2.7 Peoria Economic Subregion (NPA Code 10, Map Code VII)

The Peoria subregion includes 30 counties in the middle of Illinois, three of which are outside the Basin plan areas. In addition to the Peoria metropolitan area, the subregion includes three smaller metropolitan areas–Champaign-Urbana, Decatur, and Springfield.

(1) Population – In 1960 the subregion included nearly 1.5 million persons, 10 percent more than in 1950. In the coming decade the population is projected to increase about 1 percent annually, slower than the rates for the Nation, multistate and Basin areas. After 1970 the subregion's population gain is expected to be about equal to that in the other areas, passing 2.5 million in 2000, and 3.5 million in 2020. The population gains have been and are expected to continue to be accompanied by a net emigration, most of which is in the young adult class between 15 and 24 years old.

(2) Labor Force – As shown in *Table P-59*, the labor force is projected to grow very slightly during the 1960's but to show an increase thereafter, approaching 1 million by the turn of the century, nearly 400,000 more than its 1960 level. The labor participation rate in the subregion, for both men and women, has been lower than that of the Basin but higher than in the Nation and multistate areas. By the turn of the century the region's labor participation is expected to equal that of the Basin but to remain higher than the participation in the Nation and multistate area.

(3) Income – Personal income per capita in 1960 was $2,200 lower than that of the Nation, multistate, and Basin areas; it is expected to remain relatively low, reaching $6,300 by the turn of the century. This growth is slower than in the multistate area and Nation, but faster than in the Basin area.

(4) Employment – Civilian employment in the subregion is expected to approach 1 million by the turn of the century and rise to 1.3 million by 2020, nearly an 800,000 increase over the 1960 level of over 500,000. The rate of employment increase is expected to be slower in the 1960's than in the Nation, multistate, and Basin areas, but after 1970 it is expected to increase more rapidly than in the other areas.

Export employment increased more rapidly in the subregion than in the total Basin in the 1950–60 period; it is expected to maintain this relationship to the turn of the century. The Peoria subregion was the only one in the Basin in which export employment increased faster than residentiary employment in the 1950–60 period. This, however, is not likely to continue. The projections show a relatively rapid growth in residentiary employment, and the export-residentiary employment ratio which was 1.1 to 1 in 1960 rises to 1.6 to 1 by the end of the century.

In 1960, agriculture accounted for 11 percent of the subregion's jobs, a decline of 5 percent in the 1950–60 period. In the future years, agriculture is expected to continue its decline both in numbers employed and as a percent of regional employment, dropping from 60,000 to 30,000 by the year 2020 and declining to 2.5 percent of employment. Mining employs a small and declining share of the subregion's workers. Manufacturing is the largest industry in the subregion, employing one-fourth of the workers in 1960. The industry is expected to grow but not as rapidly as the total regional employment, thus declining to less than one-fifth of all workers by 2020.

Table P-59

Selected Summary Data,
Subregion 10 – Peoria
(NPA Code 10, Map Code VII)

	Unit	*1950*	*1960*	*1970*	*1980*	*1990*	*2000*	*2010*	*2020*
Population	thousands	1,334	1,470	1,616	1,937	2,251	2,621	3,079	3,645
Students	thousands	33	45	71	100	99	108	–	–
Total, excluding students	thousands	1,301	1,425	1,545	1,837	2,152	2,513	–	–
Male	thousands	642	692	735	892	1,053	1,233	–	–
Female	thousands	659	733	810	944	1,099	1,280	–	–
Total, 15–69 yrs. excl. students	thousands	882	883	942	1,134	1,297	1,521	–	–
Male	thousands	433	424	443	549	634	746	–	–
Female	thousands	449	459	499	585	663	775	–	–
Total, excluding rural farm	thousands	1,098	1,283	1,454	1,800	2,126	2,508	2,976	3,553
Labor Force:									
Total	thousands	–	573	577	678	804	953	–	–
Male	thousands	–	395	372	430	514	609	–	–
Female	thousands	–	178	205	247	290	343	–	–
Labor Force Participation Rate:									
Total	percent	–	60.4	61.8	60.2	62.4	63.0	–	–
Male	percent	–	84.9	85.6	79.6	82.2	82.6	–	–
Female	percent	–	36.8	41.1	42.3	43.8	44.3	–	–
Employment (jobs):									
Total	thousands	491	524	584	696	816	958	1,125	1,311
Export	thousands	221	246	265	296	327	375	–	–
Residentiary	thousands	270	278	318	400	489	583	–	–
Total Employment (persons)	thousands	–	–	543	661	775	910	–	–
Unemployment Rate	percent	3.2	4.2	5.9	2.5	3.6	4.5	–	–
Personal Income:									
Total	mil. 1960 $	2,430	3,219	4,782	7,403	11,004	16,598	24,793	36,443
Wages and salaries	mil. 1960 $	1,794	2,360	3,443	5,224	7,593	11,403	–	–
Other income	mil. 1960 $	636	859	1,339	2,239	3,411	5,195	–	–
Per capita	1960 $	1,821	2,189	2,959	3,853	4,888	6,333	8,052	9,997
Wages and salaries per employee	1960 $	3,652	4,505	5,900	7,510	9,306	11,903	–	–

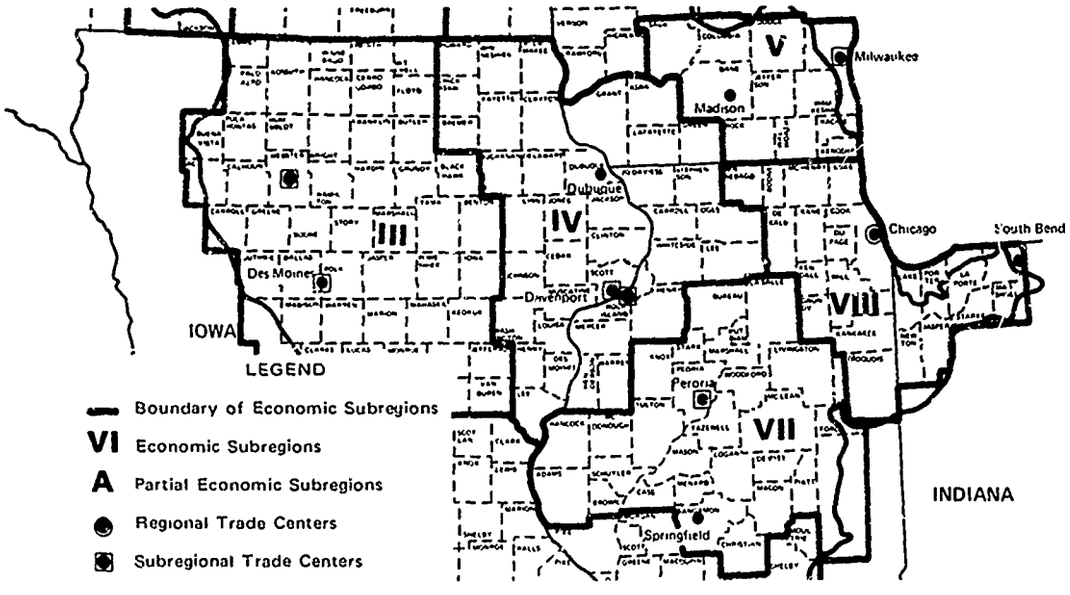

Figure P-33. Upper Mississippi River Basin Economic Subregion 10.

Nonelectric machinery and equipment is the largest manufacturing industry in the subregion, and is expected to remain so through the turn of the century, even though it is projected to grow more slowly than overall manufacturing. The food and kindred products industry ranks second in manufacturing employment, but since it is not expected to change its employment through the end of the century, it loses its second rank to the rapidly growing electrical machinery and equipment industry by 1980. The stone, clay and glass products and fabricated metals industries also have large numbers of employees, and the latter is projected to grow relatively rapidly. Growth in the primary metals industry is expected to put it among the larger manufacturing industries, reaching 13,000 employees by the year 2000; services, now second to manufacturing in employment, is expected to be the largest employer in 1970. By the year 2020 services is projected to provide over 400,000 jobs.

Retail trade is one of the largest of the noncommodity industries, but it is not expected to increase as rapidly as total regional employment. Wholesale trade is expected to increase more rapidly than the retail component, more than doubling in employment for the 1960–2020 period and increasing its share of the subregion's employment by almost 1 percentage point. Employment in the construction industry is expected to grow more rapidly than regional employment until 1990, but to slow down in its growth thereafter. In numerical terms, construction employment is expected to increase to two and a half times its 1960 level of 30,000 by the year 2020.

Government is expected to be the most rapidly growing sector in the subregion, reaching 165,000 by the year 2020, six times its 1960 level; it is expected to rise from 20 to 30 percent of regional employment. Finance, insurance, and real estate is also expected to grow rapidly, quadrupling its employment in the 1960–2020 period and increasing its share of total employment from 4 to 7 percent in the same period. The transportation, communications, and public utilities sector is not expected to increase its employment, thus rapidly declining as a share of regional employment from over 7 percent in 1960 to 3 percent in the year 2020.

2.4.2.8 St. Louis Economic Subregion (NFA Code 11, Map Code VI)

The St. Louis subregion includes 27 counties in the southwestern part of Illinois and 43 counties in the eastern portion of Missouri, six of which are outside the Basin plan areas. Although most of the counties are agricultural, the economy is dominated by the urban-industrial complex of St. Louis, the ninth largest metropolitan area of the Nation.

(1) Population – The subregion's population, which was 3 1/3 million in 1960, an increase of more than 10 percent over the 1950's, is projected to approach 6 million by the turn of the century and 8 million by the year 2020. The past and projected rate of population increase is lower than that for the Nation and total Basin but about the same as in the multistate area. In spite of the population growth, the subregion has experienced net emigration and is expected to continue as an emigrant area.

(2) Labor Force – The labor force in the subregion is expected to grow less rapidly than in the Nation, multistate, and Basin area, increasing from almost 1.3 million in 1960 to over 2 million at the turn of the century. The participation of regional population in the labor force has been and is expected to continue at a higher rate than in the Nation or multistate area but lower than in the total Basin area. This relationship holds true for both men and women.

(3) Personal Income – Personal income per capita has been and is expected to remain lower in the subregion than in the Nation, multistate, and Basin areas. Per capita income is projected to increase slower than in the Nation and multistate area, but faster than the rate of increase for the Basin between 1960 and 2020. As shown in *Table P-60*, in 2020, per capita income in the area is expected to approach $9,700, compared with $2,200 in 1960. Total personal income in the subregion is projected to increase at about the same pace as in the multistate and Basin area, but less than in the Nation, even though in the 1950–60 period, the regional personal income increased at a slower pace than in the other areas.

(4) Employment – Civilian employment in the subregion is expected to increase from over 1 million in 1960 to over 2 million at the turn of the century and to approach 3 million by 2020. The projected rate of the subregion's employment change is higher than that of the multistate area, about the same as the Basin's but lower than in the Nation. In the 1950–60 decade the subregion's rate of employment growth was lower than in the other areas.

Export industry employment grew very slowly in the 1950–60 period but is expected to rise more rapidly. Residentiary industry employment is expected to grow faster than in the remainder of the Basin, as well as faster than export employment. The amount of residentiary employment in relation to

Table P-60
Selected Summary Data,
Subregion 11 – St. Louis
(NPA Code 11, Map Code VI)

	Unit	1950	1969	1970	1980	1990	2000	2010	2020
Population	thousands	3,002	3,329	3,829	4,354	5,065	5,845	6,734	7,785
Students	thousands	28	44	89	123	126	140	–	–
Total, excluding students	thousands	2,973	3,285	3,740	4,231	4,939	5,705	–	–
Male	thousands	1,460	1,591	1,804	2,059	2,423	2,804	–	–
Female	thousands	1,000	981	1,106	1,264	1,466	1,697	–	–
Total, 15–69 yrs. excl. students	thousands	2,052	2,052	2,302	2,611	2,996	3,463	–	–
Male	thousands	1,513	1,694	1,935	2,172	2,516	2,901	–	–
Female	thousands	1,053	1,071	1,197	1,347	1,529	1,766	–	–
Total, excluding rural farm	thousands	2,549	2,034	3,573	4,137	4,851	5,635	6,542	7,612
Labor Force:									
Total	thousands	–	1,255	1,369	1,569	1,803	2,109	–	–
Male	thousands	–	851	863	1,005	1,155	1,358	–	–
Female	thousands	–	403	486	563	642	750	–	–
Labor Force Participation Rate:									
Total	percent	–	58.4	59.6	60.2	60.3	61.0	–	–
Male	percent	–	82.6	80.2	79.8	79.6	80.3	–	–
Female	percent	–	36.4	40.6	41.9	42.4	42.5	–	–
Employment (jobs):									
Total	thousands	1,144	1,175	1,356	1,585	1,822	2,110	2,422	2,770
Export	thousands	540	545	587	616	678	760	–	–
Residentiary	thousands	603	628	770	969	1,144	1,350	–	–
Total Employment (persons)	thousands	–	–	1,316	1,506	1,731	2,005	–	–
Unemployment Rate	percent	4.4	4.6	3.9	4.0	4.0	4.9	–	–
Personal Income:									
Total	mil. 1960 $	5,399	7,181	11,113	16,567	24,214	36,046	52,652	75,342
Wages and salaries	mil. 1960 $	3,851	5,028	7,668	11,343	16,465	24,511	–	–
Other income	mil. 1960 $	549	2,153	3,445	5,219	7,748	11,535	–	–
Per capita	1960 $	1,798	2,157	2,903	3,805	4,781	6,167	7,820	9,678
Wages and salaries per employee	1960 $	3,367	4,280	5,652	7,159	9,037	11,616	–	–

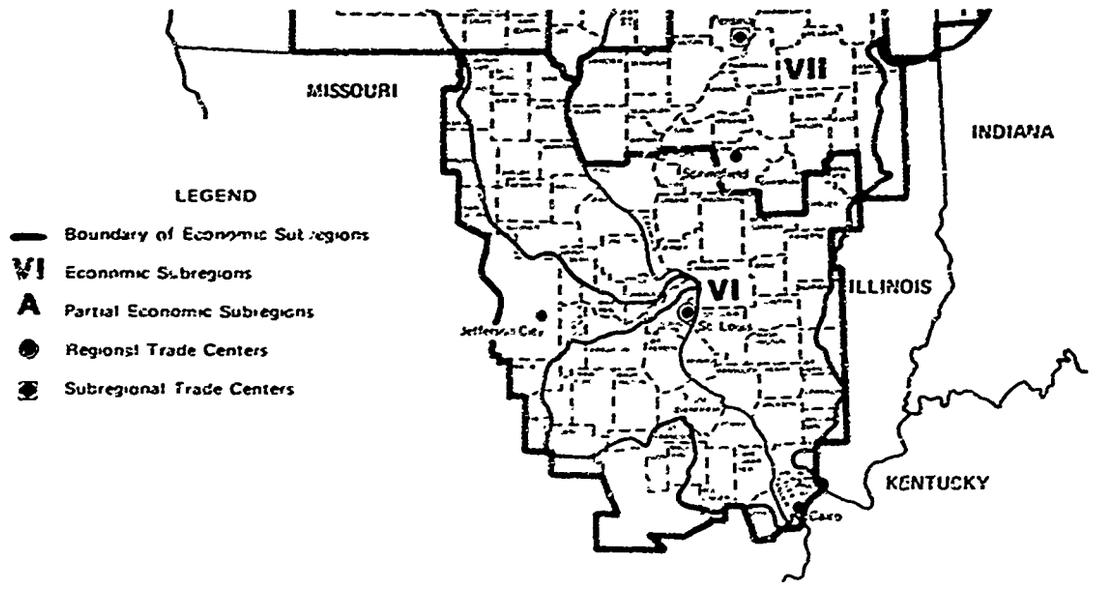

Figure P-34. Upper Mississippi River Basin Economic Subregion 11.

export employment is expected to rise from about six residentiary per five export employees in 1960 to nearly nine to five by the turn of the century.

Agricultural employment declined by more than one-third during the decade of the 1950's decreasing its share of the subregion's employment from 12 to 7 percent. A continued, but not as precipitous a decline in agriculture is projected, so that the industry employment drops by another third to the year 2000, declining to less than 3 percent of employment. Mining employment dropped to less than 14,000 in 1960, half its 1950 level, but it is not expected to decline further in the future. Manufacturing is the largest employer in the subregion; it provided nearly 330,000 jobs in 1960, a quarter of total employment. While it is expected to grow to approach half a million jobs by 2020, this indicates a fall to 20 percent of the subregion's employment.

The largest manufacturing industry is transportation equipment which, partly because of the aerospace manufacturing activity in the St. Louis area, increased by two-thirds in the 1950 60 period. The industry is projected to pass 85,000 employees by the year 2000, 60 percent more than the 50,000 level in 1960. Food and kindred products manufacturing was the second largest manufacturing industry in 1960. However, employment in this sector is not expected to increase in the future, so that it cedes its rank to nonelectric machinery which is expected to double in employment during the 1960 2000 decades.

Other large manufacturing industries in this diversified area are primary and fabricated metals, electrical equipment, chemicals, and printing and publishing all expected to increase in employment, while apparel, leather and plastics products and stone, clay and glass products are all expected to decrease in employment size in the 1960–2000 period.

Services, ranking second to manufacturing in employment in 1960, is projected to be in first place by 1980. Between 1960 and 2020, services is expected to increase by a factor of nearly three, growing from 240,000 to 950,000 and raising its share of regional employment from one-fifth to more than one-third. Retail trade is expected to almost double from 180,000 to 350,000, between 1960 and 2020, but in spite of this growth, is projected to decline as a share of the subregion's total employment. Wholesale trade is expected to triple in the same period, slowly increasing its share of employment to 1990. Government is expected to be the fastest growing employer in the area increasing by a factor of five between 1960 and 2020. This growth from 57,000 to 335,000 indicates that its share of the subregion's employment rises from 5 to 12 percent.

Finance, insurance and real estate is expected to grow by three and a half times between 1960 2020, rising from 50,000 to over 225,000 and doubling its 1960 share of 4 percent of regional employment by 2020. The construction industry is expected to employ almost twice as many workers in 2020 as in 1960, increasing to more than 120,000 but remaining at about a constant 5 percent of the subregion's employment. Transportation, communications and public utilities is expected to decline from about 8 percent of 1960 regional employment to 4 percent by 2020, while retaining a nearly constant level of workers at just below 100,000 through the entire period.

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Section 3
AGRICULTURAL ECONOMY OF THE UPPER MISSISSIPPI RIVER BASIN

3.1 Introduction

3.1.1 Objective and Scope of Study

This discussion of the agricultural activity within the Upper Mississippi River Basin for specific future time periods provides a basis for estimating the agricultural land and water needs to meet the public demand for food and fiber. Projections of the agricultural economy suggest land-use and crop-distribution patterns, estimate the rural farm population and employment, and provide an evaluation of total agricultural production in the Basin. The direct purpose of these studies is to assist in evaluating the importance of alternative water resource investment programs to help meet some of the various objectives and desires of local citizens and the public at large.

The general procedure was to determine the demand for agricultural products, determine the supply potential–that is, the productive capacity of the Basin, and then point out ways Basin farmers might choose to meet demands considering the resources at their disposal and the costs they must sustain.

Essentially, this procedure followed three phases. First, estimates were made of national requirements for food, feed, and fiber and the regional location of the production. Based on the national requirements for the years 1980, 2000, and 2020, USDA estimates were made of the share of national demand for various agricultural products which will have to be supplied from the Basin. This estimate reflects the comparative advantage of this Basin in feed production relative to other regions of the country the interregional competitive factors such as land productivity and processing and marketing costs. Second, the procedure required an analysis of the productive capacity of the Basin service area to produce food and fiber. This involved an estimate of the yields of the various crops which could be expected from the various soil groups and the costs of obtaining those yields under average weather and management conditions. Third, the demand and supply possibilities were brought together in a computerized analytical system designed to simulate the decision process of the producers who control the resources and have to incur the costs of meeting the demands. The results of the computer program provided the estimates of production of the several crops in the various regions of the Basin. Labor requirements were derived from the crop pattern and associated crop and livestock production. Population estimates were derived from the employment pattern.

3.1.2 Relationship to Appendix N, Agriculture

The information contained in this part of Appendix P, provides a summary of the agricultural economy and some additional detail on projection methodology. It was considered that those using this appendix would be concerned with methods and projection figures, while those using Appendix N would be primarily interested in the agricultural economy and in the significance of water resources for that sector. Therefore, at this point, Section 3 does not discuss the water resource potential for agriculture, however, Section 9 of Appendix N does discuss the impact of the proposed plans of water resource development on the several economic sectors, including agriculture.

3.2 Methods and Assumptions

3.2.1 Basin Geographic Organization for the Study

Section 2 of this appendix provides full discussion of the spatial organization of the Basin and the following summarizes that information. *Figure P-3* indicates the geographic location of the Basin plan areas. *Figure P-23* indicates the location of the economic subregions.

3.2.2 Methodological Approach

For explicatory purposes this methodology discussion emphasizes the projections of demand for, and production of, feed grains.

Feed-grain demand and roughage needs depend on the expected consumption of livestock products plus export demand. The Economic Research Service estimated that the national demand for meat, milk and eggs will increase about three times by the year 2020. Part of the national demand was then allocated to the Basin, one of the 16 major water resource regions in the United States. The allocation was based on historical trends in regional production, with special attention to regional shifts in production and in the export balance.

Feed-crop production was estimated on the basis of the livestock product requirements, according to the ration deemed most applicable for each region. The feed-grain levels reflect estimates of future livestock feed efficiencies in

converting feed into livestock products. Improved livestock breeds, better feed management, and improvements in crop varieties are expected to reduce the feed-grain requirements per unit of livestock products produced. In accordance with these considerations, and following the expected substantial rise in meat consumption, the requirements for feed grain in the Basin were estimated to increase in 2020 to about two and three-quarter times the 1959–61 average production.

While this report presents results in terms of feed grain, food grain, roughage, and specialty crops, the projection technique required estimates of specific crops. Feed grains, for example, consist of corn grain, sorghum grain, oats and barley in varying proportions according to the livestock enterprise and the climate and soil potential for producing the crops. Thus, the demand side of the study was translated into the production framework in terms of twelve different crops, including wheat and soybeans, hay, pasture, and silage as well as the above feed crops.

The supply side of the study hinges on the production potential of the land resource in the Basin. One of the first tasks was to take an inventory of the existing crop and pasture land base which was provided by the Inventory of Soil and Water Conservation Needs undertaken by the USDA in 1953. This inventory identified the kind and acreage of soils in the major Land Resource Areas.

Land Resource Areas may involve all or parts of several counties. Each area is characterized by similarity in climatic conditions and contains soils of a common origin. (See discussion in Appendix N, Agriculture, and subsection 3.3.3 of this appendix.) Land Resource Area 90, for example, identifies a group of soils found in central Wisconsin and Minnesota. This region generally contains relatively poor soils and experiences a cool, short growing season which imposes severe restrictions on agriculture. Land Resource Area 108, on the other hand, identifies a group of soils found in central Illinois and Iowa. The area is characterized as generally containing fertile soils and has a climate conducive to bountiful production. With a favorable annual precipitation pattern, it is one of the outstanding grain-producing regions of the world.

Within each LRA the soils are grouped into homogeneous economic classifications, Land Capability Unit Groups (LCU Groups). The soils within a group produce similar crop yields, have similar production costs, and are characterized by similar inhibitory factors. These inhibitory factors include:

(1) Wet – needs drainage.
(2) Droughty – needs irrigation.
(3) Flood plain – could benefit from flood protection.
(4) Erosion problems associated with slope characteristics and soil texture.
(5) Other factors, such as chemical limitations and stoniness.

Not all of the land inventoried in the USDA investigation will be available for agricultural production in 1980, 2000, or 2020. Land requirements for urban residences, industry, transportation, and recreation are increasing rather substantially. Therefore, the land area available for agricultural production was reduced. Based on the relation of urban population growth to land area change and considering the projections of various planning agencies, this trend is likely to continue (*Table P58*). After deducting the land required for urban development, the remaining crop and pasture land was considered available for use by those crops which could be grown on it most efficiently, under assumed management and technology.

For each LCU group available for crop production, the yield potential was estimated for each crop and pasture use, considering the fertilizer requirements associated with each crop. The projected yields were based on expected technological changes and represent average normalized yields that reflect the normal climatic, disease, and insect hazards that are expected to affect yields in the future. The costs of production for each crop for individual LCU groups were also estimated. These costs were composed of preharvest and harvest costs, and where appropriate, the specific cost which would be incurred in attempting to farm difficult land slopes in some soil groupings.

For example, Land Resource Area No. 90 in the northern part of the Basin contains a soil group, designated #72, which is well-drained, course-textured, shallow to bedrock–a gravel soil of the uplands. If by chance it were placed into production of corn in 2000, it could produce 46 bushels per acre under average management at a cost of 99 cents a bushel. Land Resource Area No. 108, on the other hand, in the lower central portion of the Basin contains a soil group, designated #3. By the year 2000, it was estimated that it will be able to produce 136 bushels per acre at a cost of about 51 cents per bushel. Other crops compete for the use of these soils but at certain costs and with corresponding yields. The question is to determine what the rational farmer, trying to maximize his return, would choose among these various alternatives considering his soils and costs, the market demands, and his ability to compete. Over the long run it was assumed that the farmer will tend to choose that set of crops which will be most economical in the use of the resources at his disposal. Over the long run the various alternatives have their opportunities to be considered and tested by the farmers by a trial and error method. But the "long run" was not

available to make projections. The substitute for this economic process is a computerized program designed to simulate the process of choosing from among t'.e various alternatives. The program is the computer's form of the economic budgeting process wherein the resources and associated costs and yields are brought together, compared, and the least costly set of crops in terms of resource use, identified and selected as representing the results of the farmer's decision process.

In the oversimplified example presented here, it is apparent that the Land Resource Area No. 90, with soil group #72 probably is too costly to use until the more efficient resources are at work. On the other hand, soil group #3 in LRA No. 108 would be most efficiently used in production of corn grain. The program takes all the demands and all the resources, compares their costs and yields, then produces a solution wherein each soil is assigned to supply the crops it can produce most efficiently. Taken into consideration are the farm production capability and cost of every other soil when considered in every possible combination that would meet the total demands placed upon them.

As must be evident, the basic space-geographic tool for the agricultural analysis is the Land Resource Area. Information must be provided, however, on the Basin plan area delineation as well as by economic subregions. (See *Figures P-3* and *P-23* and discussion in subsection 3.2.1.) The program solution was reaggregated into the several geographic units on the basis of the percent of respective land classifications in each economic region and plan area, based on the description of the Land Resource Areas in each of those units, the crop and pasture land acreage, and the acreage, yield, and production of each crop.

The projection of livestock production was made by several classes of livestock and by Basin plan area. The trend of production was determined for each Basin plan area for beef and veal, dairy cows, sheep, hogs, and for poultry and egg production. These trends were then related to the production of feed crops in each Basin plan area. Thus, the projection of livestock was tied to both the historical market and production relationships and to the projected location of production of critical feed crops.

Following the projection of crops and livestock, it was necessary to determine farm employment and population. Farm employment estimates were developed from the crop production costs which were associated with the specific acreages and crops which came into the solution. For example, in 1980, it was projected that corn grown on LRA 108, LCU Group 3, would take about 5½ man-hours per acre. By estimating the labor requirement for each crop in the same way, it was possible to compute the total hours of labor required to produce the crops needed to meet the demands for 1980. After adding man-hours required for livestock, other crops, and overhead labor, the total man-hours were converted to employee equivalents using the estimated man-hours per agricultural employee projected for 1980 by the Ad Hoc Committee. Employment for 2000 and 2020 was based on the Ad Hoc Committee productivity projections in conjunction with Basin production. Population was derived from employment on the basis of historical employee/population ratio extrapolated to the year 2020.

The preceding outlines the procedure followed to project agricultural activity under the present conditions of water resource development. Appendix N, Agriculture, summarizes the way the projections were used to identify water resource problems associated with agriculture. That appendix suggests ways in which water resource development might affect Upper Mississippi agriculture, the farmer, and the people who depend on that area for a food supply.

3.2.3 General Assumptions and Limitations

The projections of agricultural activity in the Basin were made on the basic assumption of a growing and increasingly prosperous population which will demand more and more goods and services. The specific assumptions are within the context of the outlook for the United States as suggested in Section 1 of this appendix. Projected demands for agricultural products reflect best estimates of consumer preferences, labor, and other resource efficiencies, and rates of technological developments in both mechanical-physical areas and in the bio-chemical fields. No doubt, pressures on resources may well induce new, unexpected changes in technology, in plant and animal breeding; yet, the material here assembled offers an informed judgment, on information available today, about the nature of things to come.

The Economic Task Force of the Ad Hoc Water Resources Council Staff provided data describing the economic milieu within which this Basin will find its markets. This is the source of projected change in agricultural output per farm worker. Prices for agricultural products have been taken from the adjusted normalized prices of the Water Resources Council, dated April 1966. Cost data, on the other hand, represent 1963 relationships because they were developed before uniform standards were provided for Basin studies.

Perhaps the most important assumption in this study is that market forces will play an increasing part in the decisions of farmers. While the impact of present trends in government programs influences the projections for 1980,

and to a lesser extent for 2000, the projections for the year 2020 represent the market place in action. Society may desire the agricultural economy to develop otherwise. By providing an analysis based largely on economic criteria, society will have a better basis for developing and choosing other, and perhaps more rational, action programs.

The critical assumptions used in this study are outlined below. Beginning in subsection 3.6.1.1 is a discussion of the effect of changing some of the most critical assumptions.

(1) Assumptions that affect demand for food and fiber.
   (a) The national population will increase between 35 and 40 percent during each 20-year period from 1960 through 2020 as shown in *Table P-61*. At this rate, the population level for 2020 will be 170 percent above the 1960 level.
   (b) National personal income in 1960 dollars, *Table P-61*, below, will increase over tenfold between 1960 and 2020.
   (c) Increased per capita food consumption will occur in lower income groups until 1980.
   (d) A general shift in consumption patterns will occur over time. For example, people will probably consume more beef and poultry relative to dairy products.

(2) Assumptions that affect the supply of food and fiber.
   (a) Basic agricultural land availability will be in accordance with the National Inventory of Soil and Water Conservation Needs with appropriate adjustments for projected land withdrawals for urban and other uses. *Table P-58* indicates projected urban land use.
   (b) Projected crop yields and costs are relevant estimates of future technology employed in farming, based primarily on increased adoption of presently known techniques.
   (c) Fixed livestock feed rations and feed efficiencies were assumed for each class of livestock uniformly throughout the Basin.
   (d) Farmers will continue to incur costs to prevent significant losses of soil producing capability through erosion, depletion, infertile outwash, and other factors causing deterioration of soils and reduced yields over the projection period.
   (e) In order to demonstrate the potential economic impact on agriculture of water resource development programs (irrigation, drainage, and flood protection) projections were developed for two alternative assumptions about water resource development: (This portion of Appendix P is concerned only with "1" below; see Section 8 of Appendix N, Agriculture, for more detail concerning "2" below.)
      1. No additional water resource development beyond that for which construction planning funds had been appropriated in 1966.
      2. Water developments permitted freely wherever they would permit reduced onfarm costs or where required to meet production demands placed on the Basin.
   (f) Over the long run, it was assumed that farmers would tend to organize their resources to minimize production costs and thereby take advantage of the Basin's comparative advantage for agricultural production. However, it was further assumed that changes would not occur in any drastic or dramatic way. Thus, friction elements were interposed to require at least 50 percent of the 1959 production on any land resource for 1980, about 25 percent for 2000, and no restrictions in 2020.
   (g) The institutional framework of the Basin and the Nation are assumed to remain relatively constant over time.

The major limitations existing in the study and this report are: (1) the assumptions express relationships that may not hold true in the distant future due to currently unforeseeable changes, (2) the sensitivity of slight

Table P-61

Population and Personal Income in the United States – 1960, With Projections for 1980, 2000, and 2020

Item	*1960*	*1980*	*2000*	*2020*
Population (million)	180.0	241.3	333.0	460.6
Personal income (billion 1960 dollars)	399.0	989.5	2,218.4	4,854.1

assumption changes on the budgeting model are not known in sufficient detail, and (3) the array of relevant alternatives, other than water resource development projects, for production cost reductions and for meeting food and fiber needs are not considered adequately.

3.3 Agricultural Characteristics of the Basin

3.3.1 Climate and Topography

The distribution of rainfall varies considerably within the Basin (*Figure P-35*). Annual precipitation ranges from less than 25 inches in the headwaters areas to more than 40 inches at the confluence with the Ohio River. Cold-to-warm temperatures, dry-to-humid climates characterize the region. Winters are cold and summers warm or hot. A greater proportion of the rainfall occurs during the spring and summer seasons.

Frost-free periods are extremely short in the northern part of the Basin (*Figure P-36*). In the northern part of Wisconsin, the average frost-free period is less than 100 days. In lower Illinois the growing season is twice as long. Average frost depths are more than 3 feet in upper Minnesota and Wisconsin and are less than 1 foot in Missouri and lower Illinois.

Wide differences in precipitation and temperature have a pronounced effect on the adaptability of crop and livestock production to specific areas. Likewise, the climatic differences have a significant effect on the formation of the soil, runoff, erosion, infiltration, and leaching.

The Basin is characterized by large areas of nearly level to gently rolling plains. Only occasionally small amounts of land are found with steep slopes. These occur mainly in the unglaciated area of southwestern Wisconsin and northwestern Illinois.

3.3.2 Type of Farming Area

Agriculturally, the Basin is most important as a producer of feed grain, livestock and dairy products. The Basin contains major portions of two well noted type-of-farming areas. They are the Corn Belt and the Lake States Dairy Region (*Figure P-37*). A portion of the Lake States Forest Area is included as well as small areas of grazing and truck and fruit farming. Climate and the productivity of the soils are important determinants of the kind of land use possible.

The Corn Belt area is important not only from the feed-grain producing standpoint, but is equally important for its feed-livestock production. The dairy region is located near some of the major dairy product markets. The soils and the growing season in the northern region of the Basin are well suited to a pastoral agriculture. Type-of-farming areas generally change according to the economic climate for various agricultural commodities, nevertheless, the location and productivity of the agricultural lands are important determinants of patterns of agricultural production.

3.3.3 Land Resource Area

The agricultural lands of the United States are classified into Land Resource Areas for agricultural research, planning and farm practice recommendation purposes. A Land Resource Area is a geographic unit of land, usually several thousand acres in extent, characterized by a particular combination of patterns of soils, climate, water resources, land use, and types of farming. The Land Resource Area is also distinguished by the types and severity of soil management problems. The Basin contains all or important parts of 17 LRA's (*Figure P-38*). They are shown in *Table P-62*.

LRA's 88 and 93 in northern Minnesota and northern Wisconsin are in the Lake States Forest Area. The parent material for the soils in these two areas is Wisconsin glacial drift. The climatic conditions of short growing seasons and deep frost severely limit crop and forage production in these areas.

LRA's 90, 91, and 95 are in the Dairy Region of the Basin. The soils here also have their origin in glacial drift. In LRA 95, a loess, 2 to 4 feet thick, occurs over the glacial drift. In LRA 95, fruit and truck crops are prevalent because of the metropolitan Chicago market and the more temperate climate.

The rest of the LRA's except for LRA 116 are in the feed and grain crop growing area. Most of these soils are derived from glacial drift or deep loess. The combination of favorable climate and productive soils make these areas important agriculturally. Some of LRA 116 occurs in the Meramec Basin in Missouri. The soils in this LRA are derived from limestone and shale and are not as productive as the glaciated and loessial soils of the rest of the Basin.

3.3.4 Present Agricultural Development

3.3.4.1 Farm Size and Value

The average farm in the Basin in both 1954 and 1959 was slightly more than a quarter of a section in size, about two thirds of the national average. The average size increased about 10 percent between 1954 and 1959. Among

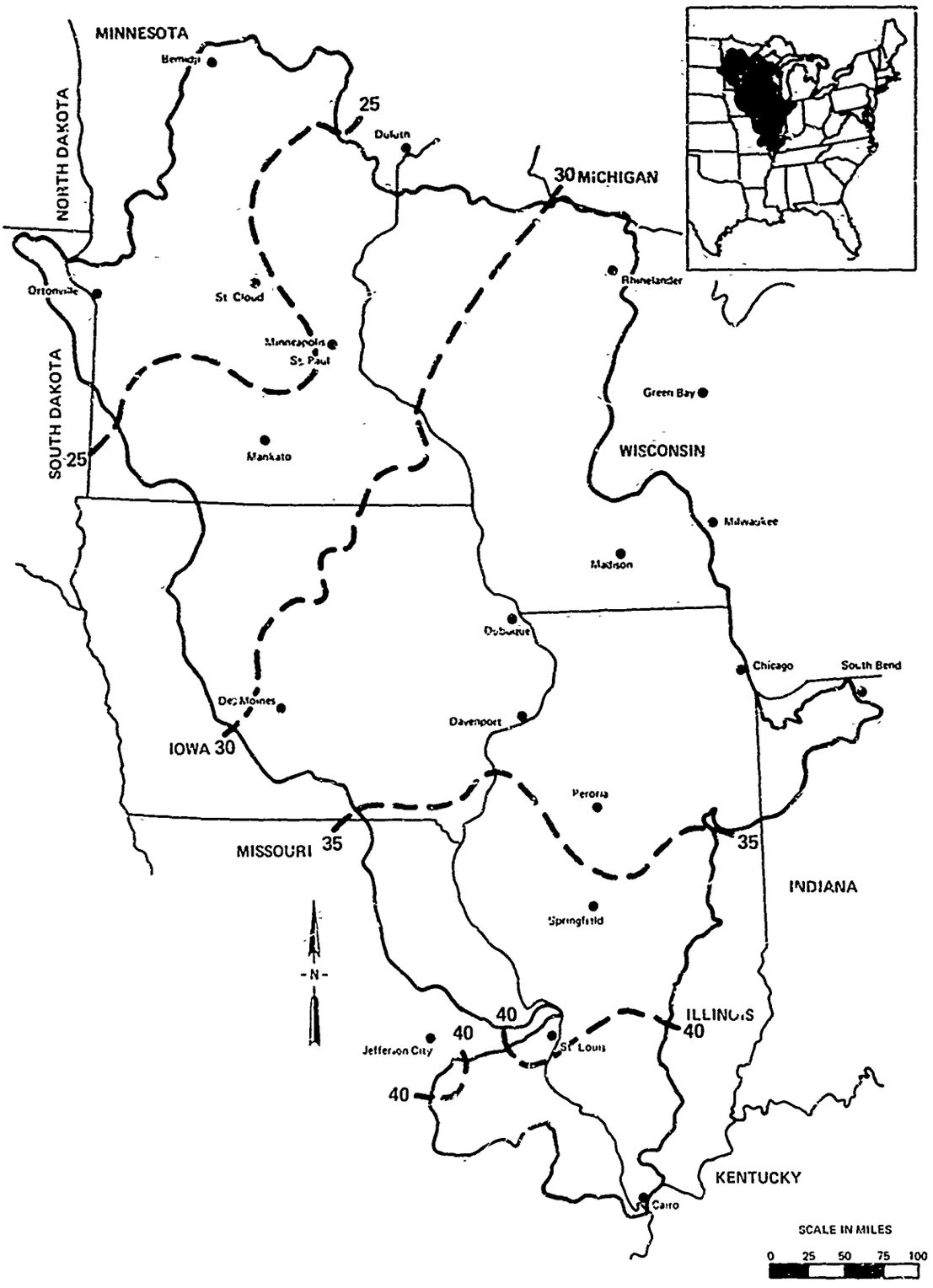

Figure P-35. Average annual precipitation (inches).

Source: "Soils of the North Central Region of the United States," North Central Regional Publication No. 76, Bulletin 544, June 1980, p. 14.

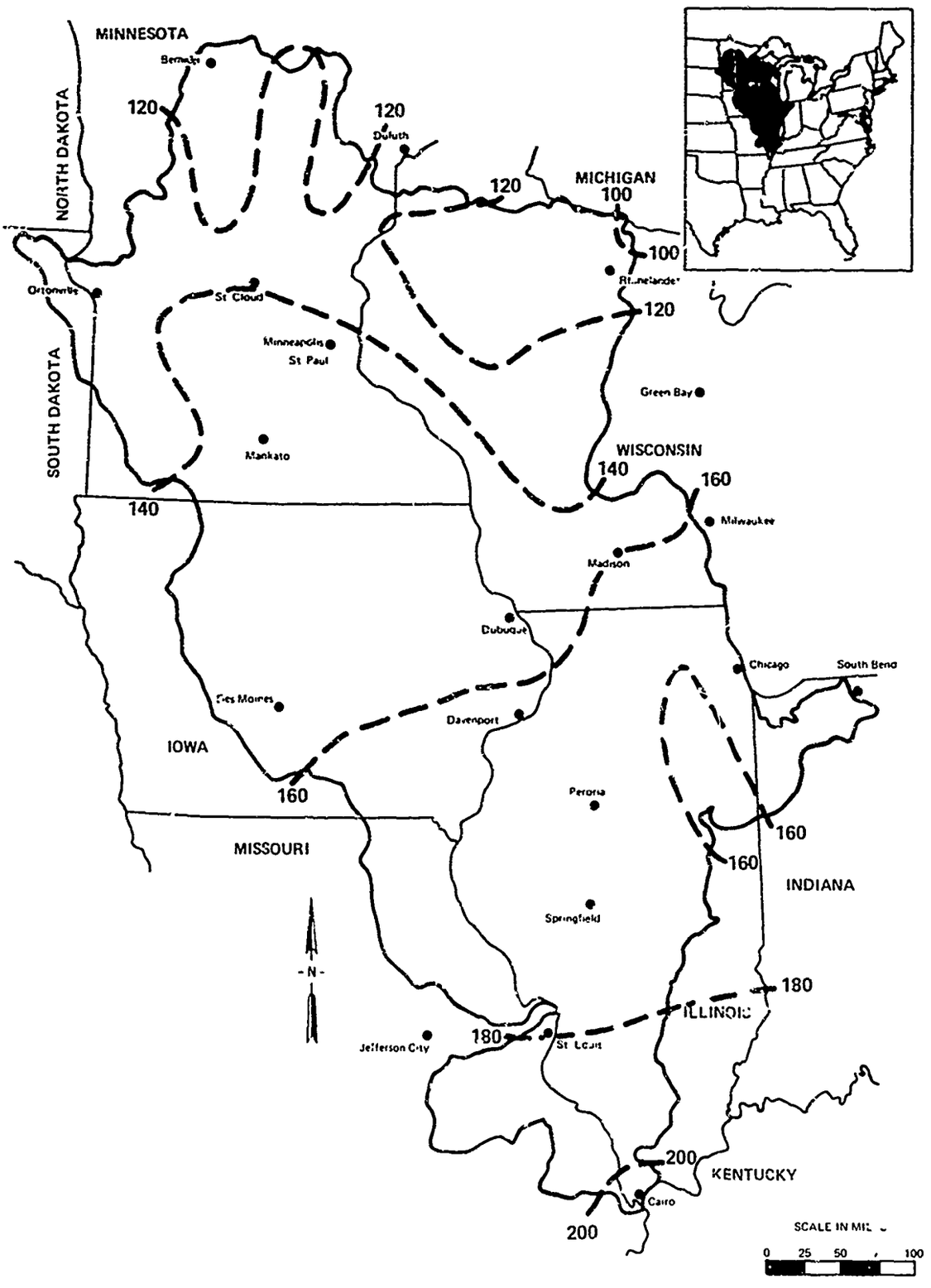

Figure P-36. Average length of frost-free period (days).

Source: "Soils of the North Central Region of the United States," North Central Regional Publication No. 76, Bulletin 544, June 1960, p. 14.

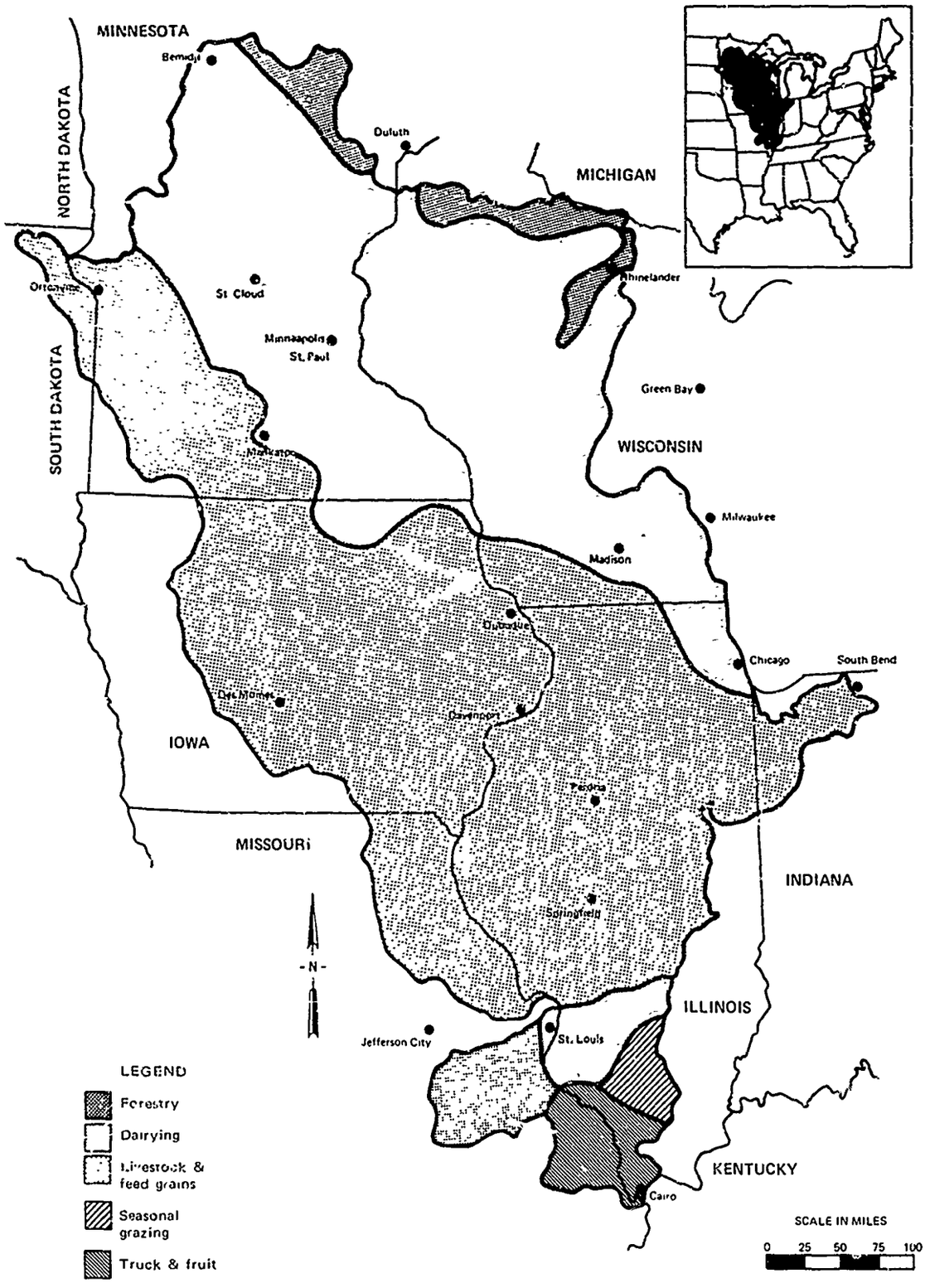

Figure P-37. Major types of farming regions.

Source: "Soils of the North Central Region of the United States," North Central Regional Publication No. 76, Bulletin 544, June 1960, p. 14.

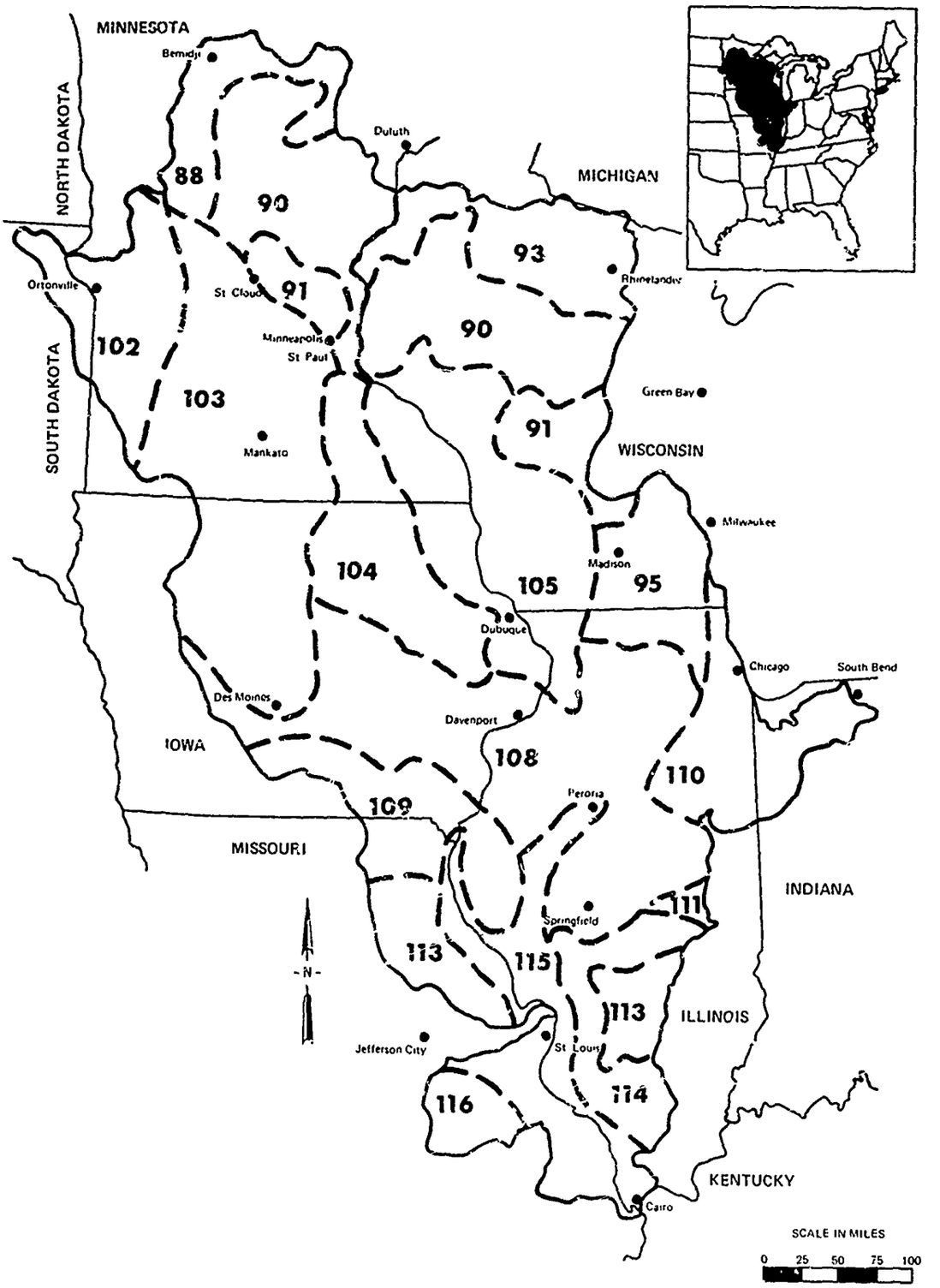

Figure P-38. Land resource areas.

Source: River Basin Atlas, SCS, January 1963.

Table P-62

Land Resource Areas in the Upper Mississippi River Basin

LRA No.	Land Resource Area[a]
83	Northern Minnesota Swamps and Lakes
90	Central Wisconsin and Minnesota Thin Loess and Till
91	Wisconsin and Minnesota Sandy Outwash
93	Northern Michigan and Wisconsin Stony, Sandy and Rocky Plains and Hills
95	Southeastern Wisconsin Drift Plain
102	Loess, Till and Sandy Prairies
103	Central Iowa and Minnesota Till Prairies
104	Eastern Iowa and Minnesota Till Prairies
105	Northern Mississippi Valley Loess Hills
108	Illinois and Iowa Deep Loess and Drift
109	Iowa and Missouri Heavy Till Plain
110	Northern Illinois and Indiana Heavy Till Plain
111	Indiana and Ohio Till Plain
113	Central Claypan Areas
114	Southern Illinois and Indiana Thin Loess and Till Plain
115	Central Mississippi Valley Wooded Slopes
116	Ozark Highland

[a] Not mentioned are four additional LRA's with only minor acreages in the Basin.

Basin plan areas farm size varied almost 100 acres, from a low of 151 acres in the Big Muddy plan area to a high of 240 acres in the Fox, Wyaconda, and Fabius plan area.

The investment in land and buildings per acre in 1959 averaged $230 in the Basin, twice the national average investment. The Basin plan area investments averaged from a low of $76 per acre in the Chippewa and Black plan area to $371 in the Illinois River plan area.

3.3.4.2 Farm Tenure

There are slightly more than one half million farm operators in the Basin. The number decreased about 65 thousand between 1954 and 1959. The Basin accounts for 14 percent of the Nation's farm operators. However, more than 18 percent of the Nation's farms operated on full-tenant basis are found in the Basin, indicating that ownership may be somewhat more prevalent in the Basin than in other parts of the country. Only 8 percent of the farms are operated by managers.

3.3.4.3 Commercial Farms

The Basin contains 422 thousand commercial farms, representing 85 percent of the farms in the Basin. A commercial farm in 1959 was defined as one on which $50 or more was grossed. Part-time farmers were excluded who worked more than 100 days off the farm or earned more from off-farm work than from products sold from the farms.

3.3.4.4 Fertilizer Use

Slightly more than 23 million acres were fertilized in the Basin, representing an acreage equal to 40 percent of the Basin's cropland or one fourth of the Basin's acreage in farms. By census definition, an acre was fertilized if any commercial fertilizer and fertilizer materials, including rock phosphate, were applied. About 2.6 million tons of commercial fertilizer were applied on farm land in the Basin in 1959, representing 13 percent of the tonnage in the United States. The census data reflect the tonnage of fertilizer purchased and not the actual nutrients applied.

3.3.4.5 Farm Population and Employment

(1) Rural Farm Population. Slightly less than 2 million people live on farms in the Basin. Compared with 1940, the 1960 rural farm population is about one million smaller. The change over the 20-year period is consistent with the national trend of absolute reductions in farm residents. Farm resident definitions were more restrictive in 1960, but only about 6 percent of the reductions was estimated to result from the definitional change. The trend toward fewer but larger farms and the age distribution of the existing farm population away from the child-bearing age are important variables in the population decline. Males outnumbered females in all census years.

(2) Rural Farm Employment. Agricultural farm employment followed much the same pattern from 1940 to 1960 as the rural farm population. Slightly more than 600 thousand workers were listed for the Basin by population census for 1960. The technological revolution in agriculture has had the effect of increasing the labor productivity in agriculture. A single farmer could produce sufficient food for 37 people in 1966. Since 1920, the output per man-hour has increased four-fold. The productivity of the American farm workers increased 6.5 percent a year after 1950 while the output per man-hour in nonagricultural industry increased about 2 percent per year. The great strides in labor productivity literally has produced involuntary underemployment in agriculture. Due to the large productivity gains in agriculture, the agricultural labor force contains many workers available for nonfarm jobs. Part-time farming is becoming a common practice. In the Upper Mississippi Basin, as in other Basins in industrial states, the combination of farm work and nonfarm work is increasing in importance.

(3) Type of Farm Employment: In 1959, the Census of Agriculture lists 876 thousand farm workers in the Basin. Full-time hired workers outnumbered seasonal workers in 1959 the reverse was true in 1954. The absolute number of regular full-time hired workers was essentially the same in the 1954 and 1959 Census for the Nation. The Basin, however, had a reduction of more than 15 percent for this time span. The reduction in seasonal workers over this time period was not as pronounced in the Basin as it was for the Nation. Family workers represent the major portion of the employment on farms. More than 80 percent of the workers on farms were either the farm operator or members of his family. The Basin accounts for about 15 percent of all family workers in the Nation but only about six percent of the hired workers. The use of hired help would appear to be more prevalent in other areas. Farms in the Basin are predominantly family size. The crop and livestock production patterns are such that work loads can be distributed somewhat over the year, thereby reducing the overall hired labor requirement.

3.3.4.6 Value of Farm Products

(1) Value of all Farm Products: Agriculture on the farm was a 5½ billion dollar business in 1959. Sales rose about one billion over 1954. In both 1945 and 1959 the Basin accounted for 17 percent of the Nation's gross agricultural sales. The prices-received index for all farm products dropped six points between the 5-year census, therefore, gross sales increased one billion in spite of lower prices.

(2) Value of Crop Production: Sales of crops in the Basin in 1959 amounted to 1½ billion dollars, an increase of about 150 million over 1954 crop sales. During the 5-year census period, the prices-received index for all crops declined 21 points and the feed-grain dropped almost 50 points. Even though there was increased crop production in the Basin, the value of sales did not increase significantly due to lower prices for the crops in 1959. The Basin accounted for 11 percent of the Nation's crop sales in both 1954 and 1959.

3.3.5 Value of Livestock and Livestock Products

Livestock and livestock products sold in the Basin in 1959 amounted to 3.7 billion dollars, 830 million more than the 1954 livestock sales. The Basin accounted for one-fifth of the livestock and livestock product sales in the Nation.

Livestock sold alive accounted for 70 percent of the total livestock and livestock product sales. Not only did the number of livestock sold increase from 1954 to 1959, but the prices received index rose 30 points for meat animals. The increased sales in part reflect the price increase. One-fourth of the Nation's livestock sold alive was produced in the Basin.

3.3.6 Land Use

In terms of physical land area there are 189 thousand square miles of land or approximately 121.0 million acres of land. The Census of Agriculture indicated that there were 96.3 million acres in farms in 1959. The difference of about 25 million acres is made up of urban places, public lands, and other private holdings not considered farms by the Census of Agriculture. The following discussion relates to the 96.3 million acres considered by the Agricultural Census.

3.3.6.1 Major Land Use

Seventy percent of the land in farms in the Basin is cropland. About 4 percent of the cropland was left idle in 1959. Ten percent of the cropland was used for pasture only.

One-third of every hectare in farms in 1959 was used as pasture. The pasture came from nearly equal proportions of cropland pasture, permanent pasture, and woodland pasture. About 13 percent of the land in farms was classified as woodland.

3.3.6.2 Principal Cropland Use

Four out of every 10 acres of cropland in the Basin were devoted to corn in 1959. Hay crops were grown on about 15 percent of the cropland. Oats and soybeans ranked next as important uses of cropland. About 3 percent of the cropland was devoted to wheat production. Nearly one-half million acres were devoted to the production of commercial vegetables and potatoes. Acreages of alfalfa, clover, and legumes mixed with timothy and other grasses represented 85 percent of the hay acreage. Alfalfa alone represented about 60 percent of the hay acreage on cropland.

3.3.6.3 Irrigated Land

Only 65 thousand acres were irrigated in 1959 in the Basin. Very few field crops and only minor amounts of commercial vegetables and potatoes were irrigated.

3.3.7 Livestock Production

Farmers in the Basin sold 3.7 billion dollars worth of livestock and livestock products in 1959. Livestock and livestock products sales represented slightly more than 20 percent of the United States sales in both 1959 and 1954. Cattle, hogs and dairy products were the principal livestock items.

3.3.8 Developments Since 1959

The information reported herein is based on the 1959 Census of Agriculture. While data from the 1964 Census of Agriculture have not been fully analyzed, it is apparent that the post-war trends have continued. For example, there are fewer farms, and the average farm was larger and more productive in 1964 than in 1959. Average yields per acre and total production for the major crops have increased. Livestock production has also risen, particularly cattle production. Farm population has continued to decline with the decrease in farm numbers.

3.3.9 Summary

The United States is highly dependent upon the agricultural products from the Basin. From one-fifth to one fourth of the livestock produced, milk and cream sold, and feed grains produced come from this Basin.

Some half million farm operators operate farms averaging about 190 acres in size and with land and building investments of around $230 per acre. Additional livestock and machinery investments make agriculture a significant part of the Basin economy.

In 1959 farmers sold more than five billion dollars worth of farm products made up principally of meat animal and dairy products.

The agricultural lands in much of the Basin are very productive and that productivity is increasing. The Basin will be able to satisfy increased demands for agricultural production, however, the development of the water resource may be very important in the use of the agricultural lands both as a means of reducing the costs of production and as a way to expand the effective production capacity.

3.4 Agricultural Production Potential

3.4.1 Production Technology

Over the past decades, output per unit of resource employed in agriculture has increased substantially. Time and again, gloomy predictions of dire shortage of food have been countered by technological developments and food surplus—at least in this country.

This is not to say, of course, that we can continue to expect the shining knight of technology to cyclically rescue the famished maiden. Nevertheless, there are important technological potentials which are alternatives to water resource development as a means of increasing food supply. This section outlines some of the more apparent technological aspects of agriculture.

Perhaps the most obvious development is that of substitution of capital equipment for labor. The increased use of automation and large capacity farm equipment has permitted larger size farms and the increase in output per man to more than double since 1940.

Not so apparent, but perhaps more significant, technological changes are effecting increases in output per unit of resource used. Improved breeding of beef and dairy stock has made substantial changes in output per animal and in

output per unit of feed consumed. These improvements are reflected in the increase in the pounds of beef or milk which can be produced on an acre of ground. In other words, fewer acres are required to produce a beef or dairy animal than in the past.

This trend has been supported by improvements in varieties of crops required for feed as well as in food crops such as wheat. Crop yields have been substantially increased also by more knowledgeable use of fertilizer.

Improvements in management techniques have had, and will continue to have an increasing impact on farm production.

3.4.2 Crop Production Projections

Yields were developed in two phases. First, preliminary crop yield projections for the five major Upper Mississippi states were developed based on a correlation of historical trends including: past yields, annual precipitation and time of precipitation, summer temperatures, and applications of fertilizers. The second phase involved review by representatives of the several experiment stations in the area. Based on their knowledge of state conditions and of current and future technological developments, adjustments were made in the projected yields where considered required.

Initial projections were made on a state basis because the data were available in that form. Subsequently, those projections were converted to the several soil groups on which production projections were to be made.

3.4.3 Production Costs

The linear programming analysis of the Basin requires cost of production for each of the programmed crops for each Land Capability Unit group in each of the Land Resource Areas. These costs were developed during 1965 using 1963 prices and such technological developments as specialists in the field could foresee for the projected years

Costs were developed for twelve crops for each of the involved Land Capability Unit groups and Land Resource Areas. These twelve crops were:

(1) Corn grain
(2) Corn silage
(3) Sorghum grain
(4) Sorghum silage
(5) Soybeans
(6) Wheat
(7) Oats
(8) Barley
(9) Alfalfa - Brome Hay
(10) Other hay including clover-timothy
(11) Cropland pasture
(12) Improved permanent pasture.

The component costs were summed to give a total crop production cost which was then coded, punched on cards, and entered into the linear program matrix for the projection years of 1980, 2000, and 2020 linear program projection analysis.

3.4.3.1 Fertilizer Costs

Prices were developed and applied in association with projected rates of application. These rates were based upon requirements of nitrogen, phosphorus, and potassium per unit of yield for ranges of yields and for groups of Land Capability Unit Groups sorted on the basis of texture.

Fertilizer element prices were based on prices from 1963 agricultural statistics. The analysis mix in which these elements would be applied would call for 40 percent of N, P_2O_5, and K_2O in the form of 3-12-12 fertilizer. Sixty percent of nitrogen (N) would be obtained from ammonium nitrate, 60 percent of phosphorus (P_2O_5) from triple phospate, and 60 percent of potassium (K_2O) from muriate of potash.

3.4.3.2 Lime Costs

Lime requirements were considered uniform for all pertinent crops. Information was obtained from a special drainage study relevant to 8-year applications of lime in each LCU group and LRA. The simple averages of all administrative area estimates were taken to establish the various LRA, LCU group estimates.

3.4.3.3 Preharvest Costs

Two sets of preharvest budgets were developed for the 12 crops under consideration. Budgets for the major portions of the Land Resource Areas assumed relatively large farm equipment. Preharvest costs for several Land Resource Areas on the very northern and southern fringes of the Basin were derived assuming relatively smaller farm size, field size, and accordingly, equipment size.

3.4.3.4 Harvest Costs

In the case of harvest operations, one set of equipment sizes was assumed for all LRA's. It was believed that availability of custom operations could permit the use of larger equipment in these areas where smaller equipment was assumed for preharvest operations.

The components of harvest costs were computed in two different ways. Some of the equipment costs were developed as total per acre cost without consideration of yield. It was felt that yield did not significantly affect these costs for a given land area. Other costs involved in harvesting were considered to be significantly affected by crop yields.

3.4.3.5 Slope Cost

Because land of varying slope requires certain treatment for erosion control when cultivated crops are grown, and also requires added labor, especially for harvesting, an attempt was made to incorporate an added charge to cover these costs. Both an added labor and erosion control cost (constant for all crops) was included for all cultivated crops and hay. For cropland pasture, only the erosion control portion of the cost was included, and for improvable permanent pasture no slope charge was made.

3.4.4 Disaggregation to Plan Areas

The data input for the linear program was developed on an LRA, LCU group basis and, of course, the results also were in the form of LRA/LCU groups. The problem then was to convert the solution by Land Resource Area cropping patterns into cropping patterns for basin plan areas and for economic subregions.

The solution for each LCU group in each LRA was disaggregated into Basin plan areas based on the proportion of the acreage in the LCU group within that plan area associated with the LRA as compared to the total acreage in the solution for that LCU group within that LRA. The result then was acreage by crop in an LRA, LCU group and in a Basin plan area. The acreage was multiplied by the projected yield for that LCU group to obtain production. The results, summed over the various LCU groups and LRA's occurring in each plan area, were then presented in the form of Basin plan areas.

The cropping patterns for Basin plan areas were allocated into economic subregions by the percentage distribution of acreage of each Basin plan area which occurred in each economic subregion.

3.5 National and Regional Food and Fiber Requirements

Future needs for agricultural products depend primarily on population and income growth, changes in consumer preferences, technological changes and requirements for exports. Production from Basin farms helps to meet demands generated locally, nationally, and for the export market. Therefore, our demand levels must be in the national context and are thus generated in national terms.

3.5.1 National Requirements

Total requirements for food and fiber are based on the projections of the Nation's population by the NPA reported in Sections 1 and 2 of this appendix. These projections represent a population increase of about two-and-a-half times the base year, 1960 level. In the same period, personal income is projected to increase 10 times in constant dollar terms. Not all the increase in income is expected to be reflected in increasing requirements for food and fiber, nevertheless, in the present lower income categories, and especially to about 1980, there appears to be substantial probability that per capita consumption will increase. After 1980, per capita consumption is assumed to remain constant.

USDA national projections of requirements for the various farm products are listed in *Table P-63*. These reflect some shift in food consumption patterns. For example, beef and poultry product per capita consumption can be expected to increase, while other meats and dairy products likely will not be in as great a demand.

Estimates of export requirements are based largely on judgments of the several commodity specialists who have been most familiar with past trends as well as with likely future patterns. The resulting projections recognize that the

Table P-63

United States Demands for Major Farm Commodities - 1959–2020

(thousands)

Commodity	*Unit*	*1959–61*	*1980*	*2000*	*2020*
Crops:					
Feed Crops	Tons	149,287	220,380	297,970	404,550
Food Crops	Bu.	1,826,968	3,206,833	4,424,649	6,128,516
Other Crops	Tons	66,992	118,991	164,261	217,990
Livestock Products:					
Beef & Veal	Lbs.	28,822,144	47,520,000	65,519,000	90,879,000
Milk & Milk Products	Lbs.	123,360,000	145,289,000	200,291,000	277,814,000
Poultry & Poultry Products	Lbs.	9,057,420	15,726,000	21,680,000	30,071,000
Eggs	Ea.	64,832,000	75,778,000	103,544,000	144,172,000
Pork	Lbs.	20,216,584	23,959,000	33,034,000	45,821,000
Lamb & Mutton	Lbs.	1,657,000	1,791,000	2,377,000	3,330,000

U.S. will continue to capture a major share of the expanding foreign market. At the same time, nations presently developing their agricultural resources can be expected to supply more and more of their own needs and, to contribute to the needs of other nations in certain categories.

3.5.2 Regional Allocation

As noted in the preceding section on methodology, the technique for projection was based in part on a demand for agricultural products established for the Basin. This demand was derived from the projection of national food, feed, and fiber needs based on the historical trends in the share of needs provided from the Basin. Commodity specialists of the USDA have injected specialized know edge of local conditions and interregional capacity in order to establish reasonable allocations. *Table P-64* shows the distribution of requirements to the Basin.

The projected increase in livestock, livestock products and poultry require substantial increases in feed and roughage production. Because of the tremendous production potential of the Basin as a whole, the large increase in demands on Basin farmers is only expected.

3.6 Projected Production Patterns for Crops and Livestock

The purpose of this section is to discuss projections of land use and livestock production under the assumption listed previously. Shifts in the cropping pattern distribution for the various basin plan areas are considered, and the significance of critical assumption are outlined. The potential for agricultural water resource development is contained in Appendix N, Agriculture; Section 8 of the appendix discusses the effect of the proposed plans of development on the agricultural economy.

Table P-65 presents present and projected values of crops and livestock by basin plan area. *Table P-66* through *P-70* show present and projected crop and pastureland used by basin plan areas.

Table P-64

Upper Mississippi River Basin Demand for Major Farm Products – 1959–2020

(thousands)

Commodity	*Unit*	*1959–61*	*1980*	*2000*	*2020*
Crops:					
Feed Crops	Tons	49,611	76,648	103,580	140,610
Food Crops	Bu.	274,179	541,155	746,760	1,034,419
Other Crops	Tons	1,996	2,968	4,093	5,677
Livestock Products:					
Beef & Veal	Lbs.	4,847,000	8,062,000	11,115,000	15,418,000
Milk & Milk Products	Lbs.	29,143,000	34,586,000	47,679,000	66,134,000
Poultry & Poultry Products	Lbs.	707,000	1,122,000	1,457,000	2,021,000
Eggs	Ea.	11,793,000	10,654,000	14,615,000	20,271,000
Pork	Lbs.	8,068,000	10,241,000	14,118,000	19,583,000
Lamb & Mutton	Lbs.	184,000	190,000	265,000	371,000

3.6.1 Basin Cropping Patterns

To simplify the discussion, plan areas are placed into northern, central, and southern groups, based on such unifying attributes as climate and geology. Generally, the plan areas within each of these groups tend to respond similarly to the economic pressures generated by the model's assumptions. Plan Areas 1, 2, 3, 4, 15, and 16 were grouped as northern; 5, 11, 12, 13, and 14 as central; and 6, 7, 8, 9, and 10 as southern. Plan Areas 14 and 16 tend to deviate from the land use patterns of their respective groups.

Developing the data used in the programming model required several assumptions. Necessarily, these are limitations on the projections. The assumptions listed in subsection 3.2.3 are based upon current knowledge of agricultural techniques and technology and current expectations of future changes within the agricultural sector of the Basin's economy. A detailed discussion of cropping pattern changes resulting from different assumptions is presented subsequently, beginning in subsection 3.6.1.1.

For purposes of this report, the major crops are classified as food grains, feed grains, roughage crops, and permanent pasture. Included in the food grain category are wheat and soybeans since they are primarily the products going toward major food uses such as bread and protein nourishment. Feed grains are composed of corn grain, oats, barley, and sorghum grain. These are used primarily as feed in the livestock ration. Roughages include hay and silage crops as well as cropland use for pasture while permanent pasture is treated separately. In addition to these is a category entitled miscellaneous crops that is composed of vegetables, fruits, potatoes, rye, flaxseed, and tobacco. Miscellaneous crops use only a small percentage of Basin land, although each may be very significant in specific locations. The nonharvested category includes idle land and land that was planted, but not harvested.

An analysis of trends in the cropping pattern projections indicated that feed grains and food grains will tend to be produced in the northern portion of the Basin. Food crop acreages also increase in the central group of plan areas. Food and feed grains acreage are projected to decrease in the long run in the southern category. The central areas are projected to experience a decrease in feed-crop acreages.

Roughages will tend to be located in the southern group of plan areas. Although on a historical basis, the plan areas in the northern group had large amounts of land devoted to roughages, projections indicate decreasing amounts in this region. Central parts of the Basin are projected to decrease the amount of roughage land by 1980, but then return to about the current level by 2000. Only by 2020, when the pressures of food and fiber needs are exerted, are there increased acreages of roughages in the central region of the Basin.

Acreages of permanent pasture are projected to decrease in the northern plan areas by 1980, increase to the 1959 level by 2000, and then decrease again through 2020. This oscillation is primarily due to the sensitivity of Plan Areas 2, 3, and 15. These plan areas can shift to various alternative uses, depending on the relative intensity of land use required by various demands. The central plan areas are projected to increase land in permanent pasture use by 1980, but then decrease in 2000 and continue the decline through 2020. The southern area is projected to experience an increase in permanent pasture acreage throughout until after 2000, at which time a slight decrease will probably occur. Generally, however, the southern plan areas have an advantage in the production of pasture crops compared to other plan areas.

A percentage share analysis describes the changes in the cropping patterns that are projected to occur over time. For purposes here, the same aggregation of plan areas is used as before. *Figure P-39* depicts the percentage shares to total land devoted to the various types of crops for the northern region of the Basin.

The northern region is projected to specialize more in feed grains at the loss of roughages, permanent pasture, and nonharvested lands. The increase in the feed grains share of total acreage will probably be 41.7 percent in 1980 and 48.4 percent in 2000, contrasted to the 36.7 percent of 1959. The second alternative demand assumption for 2020 results in about 54 percent of the area's cropland in use for feed-grain production. This is a significant change over time.

This northern area will probably also specialize more in food grains. The share is projected to be 13.4 percent in 1980, about a doubling of the 6.8 percent share of 1959. The upward trend in shares will probably continue to about 16.5 percent in 2020 (under the second alternative demand assumption).

It is significant that the cooler climates of the northern region can be overcome for food and feed-grain production. That is, in the northern areas, comparative costs for producing additional food and feed grains are lower than in the remainder of the Basin, even with a shorter growing season.

Figure P-40 presents the percentage shares of crop types for the central plan areas of the Basin.

The central region appears to have a comparative advantage with specialization in food grains. This fact is not very surprising since currently the central plan areas contain most of the land in wheat and soybean production for the entire Basin. The comparative costs of production in the central region seem to be either lower than elsewhere or to be low enough to provide the most efficient land use when larger acreages are devoted to food grains.

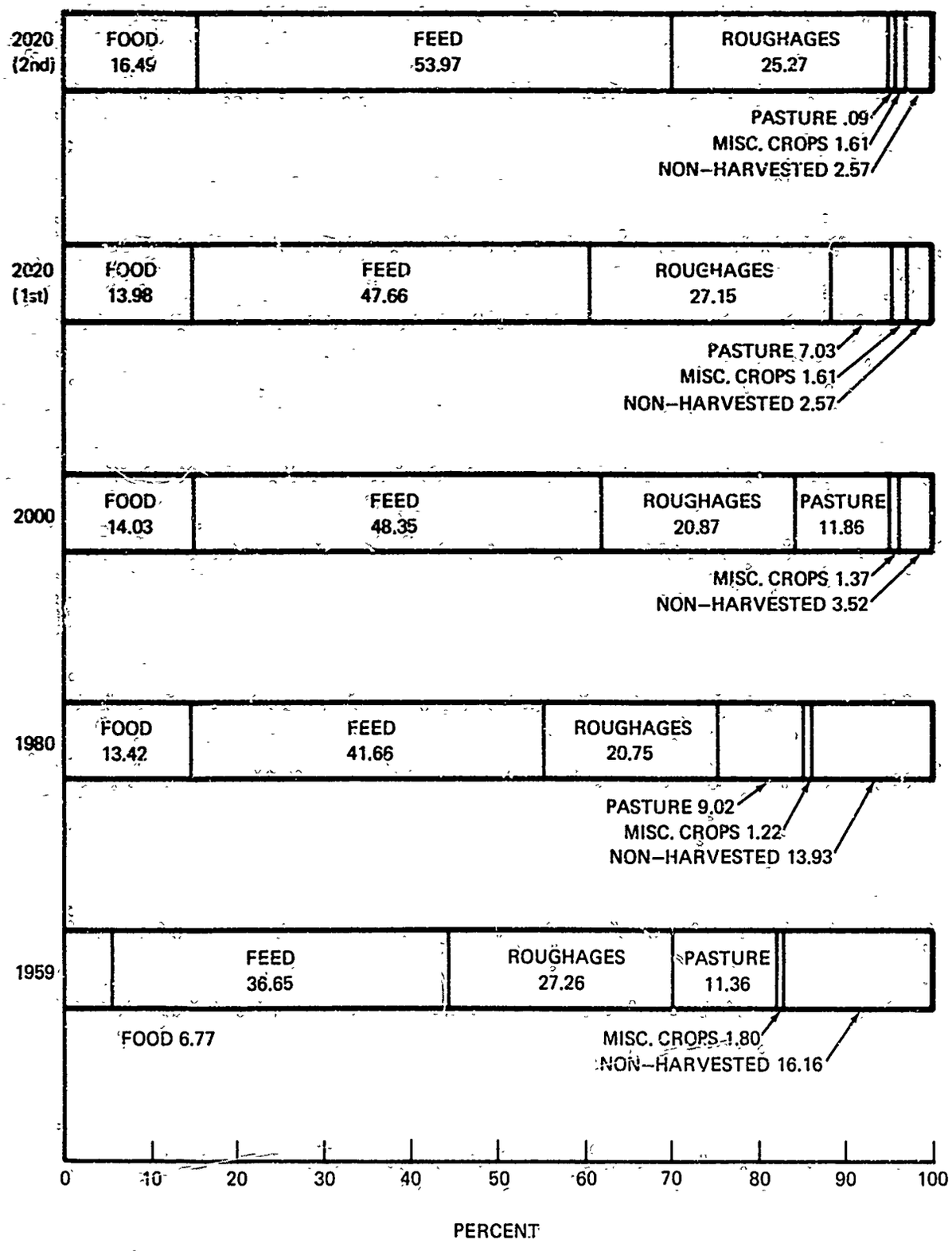

Figure P-39. Percentage shares of total acreage devoted to crop types in the Northern Areas, Upper Mississippi River Basin, without additional water development, 1959 through 2020.

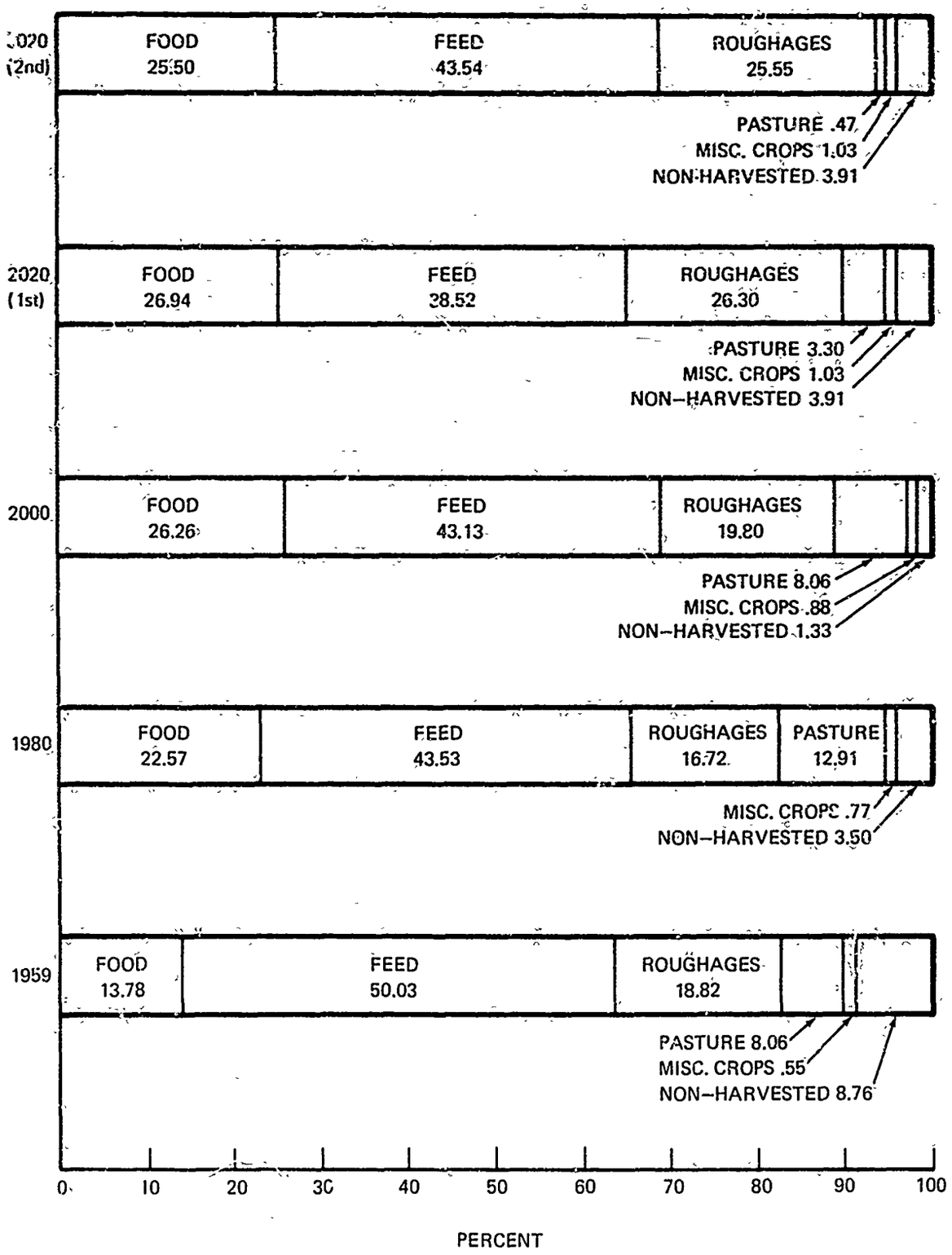

Figure P-40. Percentage shares of total acreage devoted to crop types in the Central Areas, Upper Mississippi River Basin, without additional water development, 1959 through 2020.

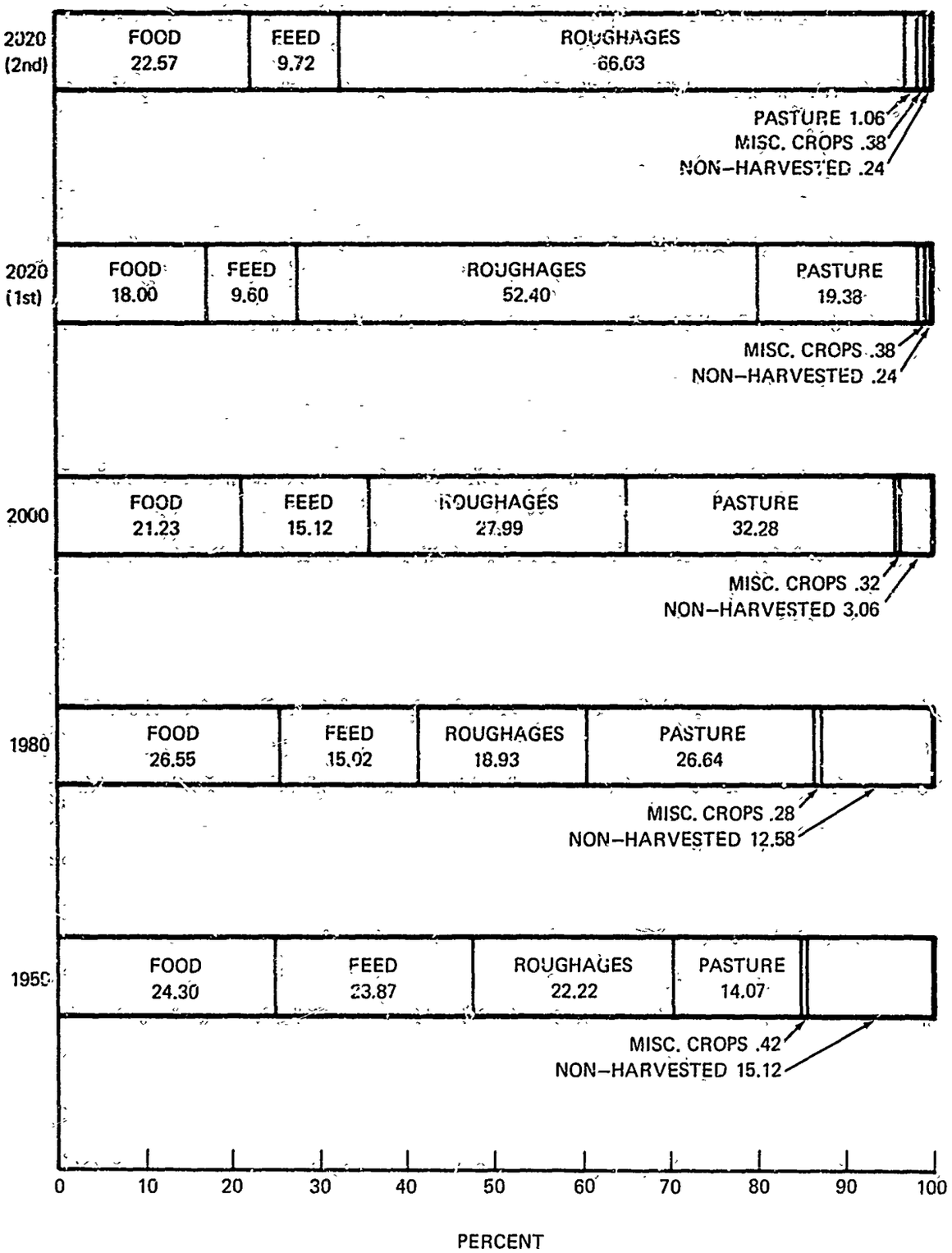

Figure P-41. Percentage shares of total acreage devoted to crop types in the Southern Areas, Upper Mississippi River Basin, without additional water development, 1959 through 2020.

Figure P-41 describes the changing trend in percentage shares for the southern group of plan areas. These plan areas of the southern group appear to be quite sensitive to changes in demand levels for the entire Basin. Soils in the region do appear to have a comparative advantage or have least disadvantage, in roughage production. The share analysis clearly depicts an increasing portion of land going for roughage crops as demand levels are increased over time. Also, notice the upward-shift of this proportion for the 2020 second assumption where more intensive use of the Basin's resources is required. Support for this argument is provided by the decreasing shares of both feed and food grains relative to the increasing shares of roughages.

In brief, the cropping pattern, under the no-additional-water-development assumption, results in a shift over time to greater amounts of food and feed-grain acreages in the northern region, while roughage crops tend toward the southern region. The central areas of the Basin are projected to produce about equally both food grains and roughages, at some comparative loss of land in feed grains and permanent pasture. The nonharvested land will become smaller over time as greater pressures for intensive land use, due to increased food and fiber demands, make it prohibitively costly to leave land idle.

3.6.1.1 Analysis of Alternative Assumptions

The cropping pattern discussed above is subject to the effects of different assumptions within the model. This section discusses some of the ways the cropping patterns might change with changes in the assumptions listed in subsection 3.2.3. Lack of funds prohibited separate computer runs for testing each modified assumption, but an economic analysis based on several solutions provides some insight to likely effects of different assumptions. More extensive discussion is found in Appendix N. To aid discussion, the forces affecting demand for food and fiber will be aggregated for an analysis, but forces affecting supply will be discussed separately.

The primary assumptions, changes in which would significantly affect the agricultural demand levels for the Basin, are as follows:*

(1) A projected national population rise greater than the currently projected level of a 170-percent *increase* between 1960 and 2020 would increase demand for food and fiber, while a lower projection would decrease that demand.

(2) A rise in personal income for the entire Nation greater than the tenfold increase by 2020 (in constant 1960 dollars) from the 1960 level may shift demand while a smaller increase might reduce the pressure on food and fiber. At this magnitude of increase, the changing food requirements likely would be more in the nature of a change in taste rather than a significant change in the quantity of nutrients required per person.

(3) A change in per capita consumption would have a corresponding effect on demand for agricultural products.

(4) A general shift in consumption patterns toward a "higher quality" diet (more meat for example) would increase the demand for agricultural products because the nutrients are supplied less efficiently. On the other hand, a shift toward a "lower quality" diet (cereals, etc.) would relieve the pressure on agricultural production.

(5) Changes in the assumption on international export demands would have a corresponding effect on requirements for food, feed, and fiber.

Changes in the assumptions which have the effect of increasing demand levels for agricultural products would require a more intensive land-use pattern and increase pressure on scarce agricultural resources. Conversely, if demand falls below that projected, agricultural resources would be under a less intensive production pattern and the pressures for resource development would lessen.

The effects of changes in demand levels are illustrated by comparing land use *Table P-69* with *Table P-70*, the latter being the pattern under greatest demand pressure. The shifts among regions emphasize the change in intensity of land use.

In the group of northern plan areas, the proportion of land in both feed and food grain production would increase while the percentage in roughages and permanent pasture would decline. With increased demand, the group of central plan areas would produce a slightly larger share of the region's total feed grain. A slight decrease would be expected in food grains, roughage crops, and permanent pasture. Again, in the southern plan areas higher demand encourages greater intensity of land use. The sharpest increases occur for roughages and food grains shares of total acreage, while feed grains appear to be unaffected by the shift. The only decline in percentage share occurred for permanent pasture.

*The numbering here corresponds to that presented earlier in subsection 3.2.3, where the assumptions are listed.

The preceding discussion points up the effect of changes in demand assumption on the Basin agricultural resources. Changes in the supply assumptions may significantly affect production capability of the Basin.

The land withdrawal assumption, (2) (a) in subsection 3.2.3, places a constraint on the amount of land available for agricultural production. With increased land withdrawal, less land is available, thus a more intensive cropping pattern is required to meet given Basin demands and the sooner scarce agricultural resources would become critical. This more intensive land use would probably follow the same pattern as described above under the demand assumptions.

One of the most critical assumptions, (2)(b) in subsection 3.2.3, is that future yields and costs will change according to increased adoption of presently known technology. If society chooses to invest resources into plant and animal production genetics, substantial gains appear possible in terms of release of scarce agriculture resources for other uses. For example, if crop yields increase at a greater rate, the associated unit costs would be reduced and an acre of land would be more productive. In effect, this would permit poorer soils either to remain idle or to produce lower valued crops while production of food and feed grains could be concentrated on the better soils. The major impact of a change in this assumption is that yield increases and accompanying cost reductions are a relevant alternative to water resource development. It may be desirable for the public to support research and adoption of new yield increasing and/or cost reduction technological improvements as a partial substitute for agricultural water development projects such as flood protection, drainage, and irrigation. For example, in 2020 when the resource strain is the greatest, a yield increase of less than 20 percent would permit production of all demands without recourse to high-cost water activities.

The livestock ration assumption, (2)(c) in subsection 3.2.3, is also particularly critical for land-use projections and water requirements. Under a scarce resource situation, increasing costs likely would call for greater substitution, for example, of corn for pasture and roughage. This would result in more intensive and consequently more efficient land use. Fewer acres would be required for meat production, thus permitting more meat production or alternative land use.

In assumption (2)(d) in subsection 3.2.3, farmers were expected to continue erosion controlling practices. If erosion is not controlled as well as assumed, then greater pressure would be exerted on the Basin's agricultural resources.

3.6.2 Livestock Production Patterns

Basically, two factors were used to determine the projected production and distribution of livestock in the Upper Mississippi Study. Livestock production was assumed to follow the shifts in projected location of critical feed crops with the restriction that the historical location of livestock production would limit the fluidity of relocation. The change in gross value of livestock production is provided in *Table P-65*. Discussion of livestock production is contained in Appendix N.

3.6.3 Fertilizer Use

Projections of fertilizer use were developed in conjunction with the yield projections and the cropping pattern. A maintenance level was assumed where any nitrogen, phosphorus, or potassium, removed by the crop or by soil leaching, would be replaced by fertilizer application. Projections of use then were derived by including the fertilizer levels necessary to replace the three major nutrients taken out of the soil per unit of crop produced. After coordination with soil scientists, these data were used to project the amounts of fertilizer required by soil types and according to type of crop. Through this process, fertilizer requirements per acre were tied directly to projected yields, since yield changes vary directly with changes in levels of fertilizer application on any particular soil type. Since emphasis of this appendix is placed on the economic aspects of agriculture, fertilizer use is considered primarily as an input cost in the production process. Also, fertilizer application rates can be considered as an alternative to water resource development. The output of agricultural production could be increased through higher levels of fertilizer use, but this alternative faces three economic implications:

(1) Limits may possibly exist to the response of agricultural output due to fertilizer application
(2) Greater quantities of fertilizer require greater costs, and
(3) Poses a possible threat to water pollution.

3.6.4 Production Costs

Specific resource costs such as fertilizer, lime, and harvest costs were discussed previously. The emphasis here is to determine the costs over time that are possible with efficient land use for the alternative cases of additional water resource development, contrasted to no additional water resource development in agriculture.

Table P-65

Gross Value of Crops, Livestock and Livestock Products by Plan Area, Upper Mississippi River Basin -- Present, 1980, 2000 and 2020 (million dollars)

Plan Area	Present[a]			1980[b]			2000[b]			2020[b]		
	Crops[c]	Livestock[d]	Total	Crops[c]	Livestock[d]	Total	Crops[c]	Livestock[d]	Total	Crops[c]	Livestock[d]	Total
1. Mississippi Headwaters	159	280	440	267	424	691	333	573	906	369	857	1,226
2. Chippewa and Black	72	150	223	101	226	328	150	273	424	166	397	563
3. Wisconsin	84	158	242	109	239	348	184	328	511	200	479	679
4. Rock	341	543	884	460	717	1,176	626	839	1,465	704	997	1,701
5. Illinois:												
5A (North)	106	131	237	167	152	319	130	184	314	104	172	277
5B (South)	638	451	1,088	1,023	565	1,588	1,359	845	2,204	1,405	1,163	2,567
6. Kaskaskia	128	76	204	219	107	325	264	186	450	272	313	585
7. Big Muddy	28	20	48	67	50	116	80	69	148	76	129	205
8. Meramec	52	76	128	63	105	168	108	126	234	96	246	343
9. Salt	73	70	143	99	102	201	129	201	330	102	272	374
10. Fox, Wyaconda & Fabius	40	26	66	47	51	98	62	111	173	48	155	203
11. Des Moines	387	433	820	587	484	1,071	737	697	1,433	910	1,007	1,916
12. Skunk	92	136	228	114	168	283	152	214	369	178	260	438
13. Iowa-Cedar	333	465	798	482	573	1,055	608	698	1,306	811	920	1,731
14. Turkey, Maquoketa, Wapsipinicon & Upper Iowa	161	303	464	296	394	690	410	500	917	519	682	1,201
15. Cannon, Zumbro & Root	91	130	221	167	189	356	220	263	483	269	341	610
16. Minnesota	259	276	535	481	386	867	625	536	1,161	681	1,018	1,700
Total	3,045	3,724	6,769	4,749	4,932	9,680	6,177	6,751	12,828	6,910	9,408	16,319

[a] Source: Adapted from 1969 Census of Agriculture.
[b] Source: ERS Projections.
[c] Excludes pasture, fruits and vegetables and crops of minor importance.
[d] Includes diary products and eggs.

Table P-66

Cropland Harvested and Pastureland by Basin Plan Areas, Upper Mississippi River Basin — 1959

(thousand acres)

Source: Compiled from 1959 Agricultural Census Data by Economic Research Service

Basin Plan Area	Total	Food Grains[a]	Feed Grains[b]	Roughage Crops[c]	Permanent Pasture	Misc. Crops[d]	Non-harvested[e]
1. Mississippi Headwaters	7,233	354	2,037	2,147	899	84	1,712
2. Chippewa and Black	3,357	44	703	1,310	450	24	826
3. Wisconsin	3,948	13	793	1,380	510	66	1,186
4. Rock	7,695	204	3,568	2,210	942	113	659
5. Illinois:							
5A (North)	2,776	349	970	719	112	48	578
5B (South)	13,328	3,059	6,358	1,800	896	93	1,122
6. Kaskaskia	3,298	1,239	998	423	269	13	356
7. Big Muddy	1,275	317	266	249	83	12	348
8. Meramec	2,960	274	575	1,008	316	11	776
9. Salt	3,039	687	636	634	634	5	443
10. Fox, Wyaconda, & Fabius	1,371	326	317	285	343	7	93
11. Des Moines	9,810	1,249	4,954	1,642	1,011	40	914
12. Skunk	2,363	203	1,190	482	290	2	196
13. Iowa and Cedar	7,430	534	4,285	1,568	474	30	539
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	4,401	100	2,196	1,292	430	5	378
15. Cannon, Zumbro, & Root	2,649	192	1,071	725	276	30	355
16. Minnesota	8,895	1,468	4,159	1,397	743	285	843
Total	85,829	10,612	35,076	19,271	8,678	868	11,324

[a] Includes wheat, soybeans.
[b] Includes corn, oats, barley, sorghum grain.
[c] Includes all hay, cropland pasture, corn and sorghum silage.
[d] Includes crops planted to fruit, vegetables, oil crops and miscellaneous small grain.
[e] Includes land planted to crops and not harvested and fallow land.

The total cost of producing food, feed, and roughage crops is projected to amount to $2.66 billion in 1980 without water resource development. This is projected to increase to $3.54 billion by 2000. The values for the water development alternative are $2.58 and $3.42 billion, respectively, for 1980 and 2000. Thus, if water resource development occurred when it is most economically desirable, the cost of production would be $80 million less in 1980 than the nondevelopment case. The difference is projected to be $120 million in 2000.

The analysis for 2020 is a different case. Under the primary assumption conditions, sufficient land resources were not available to meet all of the projected food and feed demands. Two alternative assumptions were then established for the without-water resource development alternative. First, it was assumed that Basin farmers would reduce production of corn for Basin export, and continue growing other crops needed for food production and the livestock rations (see *Table P-69*). Thus, corn demand was reduced to about 65 percent of the original level. The second assumption was that Basin farmers probably would reduce production of all crops across the board, rather than reducing corn production alone (see *Table P-70*). Under this assumption and without additional water resource activity, the Basin could provide about 85 percent of original demands for all crops. The total cost of production in the nondevelopment case was $3.94 billion, assuming only a reduction in corn production. It was $4.09 billion with the 85-percent across the board demands. Strict comparability with the additional water resource development case is not possible because land is available to meet all demands if water development is allowed. However, a computer run was made with water development at 70 percent of food demands, thus enabling a comparison. Without development, costs totaled $3.15 billion compared to the $3.06 billion production costs when water resource development is allowed as they become economically desirable. These costs are lower than the 2000 time period since the demand was substantially contracted from the original levels. If all demands are met in 2020 with water development allowed, costs are projected to amount to $5.11 billion.

Even though water development tends to reduce total costs, various other alternatives may be just as desirable from a public viewpoint. Society possibly may realize a net savings by placing greater stress on improving technology

Table P-67

Cropland Harvested and Pastureland by Basin Plan Areas, Upper Mississippi River Basin – 1980

(thousand acres)

Source: Compiled by Economic Research Service

Basin Plan Area	Total	Food Grains[a]	Feed Grains[b]	Roughage Crops[c]	Permanet Pasture	Misc. Crops[d]	Non-harvested[e]
1. Mississippi Headwaters	6,962	938	2,264	1,752	898	73	1,037
2. Chippewa and Black	3,351	167	1,349	484	418	24	909
3. Wisconsin	3,931	163	1,326	798	380	40	1,224
4. Rock	7,576	1,234	3,707	1,199	622	98	716
5. Illinois:							
5A (North)	2,521	425	1,570	318	105	59	43
5B (South)	12,488	3,964	5,087	1,814	1,332	85	207
6. Kaskaskia	3,255	1,137	863	698	534	8	15
7. Big Muddy	1,272	453	260	137	394	3	25
8. Meramec	2,817	451	248	302	719	10	1,087
9. Salt	3,029	653	197	748	1,054	7	370
10. Fox, Wyaconda, & Fabius	1,349	339	157	292	363	2	196
11. Des Moines	9,784	2,222	4,102	1,543	1,480	69	368
12. Skunk	2,359	494	626	585	603	14	37
13. Iowa and Cedar	7,381	1,289	3,278	1,288	1,330	44	152
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	4,366	391	2,278	566	175	26	550
15. Cannon, Zumbro, & Root	2,578	325	1,543	199	191	17	303
16. Minnesota	8,829	1,633	3,657	2,462	486	153	438
Total	83,868	16,278	32,512	15,585	11,084	732	7,677

[a] Includes wheat, soybeans.
[b] Includes corn, oats, barley, sorghum grain.
[c] Includes all hay, cropland pasture, corn and sorghum silage.
[d] Includes crops planted to fruit, vegetable, oil crops, and miscellaneous small grain.
[e] Includes land planted to crops and not harvested and fallow land.

and/or encouraging the adoption of newer technologies. An example of this might be development of a type of barley seed that brings substantial increases in yield. This could be coupled with the development of a more efficient milling process and may enhance the use of barley in the feed ration. A shift in the feed ration may decrease the need for water development from the public viewpoint.

3.7 Rural Farm Employment and Population

The projection of farm employment is a function of the projections of production and production technology. The numbers of people employed on farms determines the number of farm families and consequently the farm population. The following paragraphs summarize the way that the preceding projection of production has been converted to projection of farm population and employment.

3.7.1 Basin Farm Employment by Economic Subregion and by Basin Plan Areas

The upper Basin has experienced considerable declines in farm employment. Between 1940 and 1950 it fell by 84.2 thousand to 872.4 thousand, it declined by 255.5 thousand during the 1950 decade to 605.8 thousand persons in 1960. Simultaneously, farm productivity has increased, thus enabling greater total output per employee. In the Upper Mississippi states, the index of output per man-hour rose from 38 in 1940 to 62 in 1950 and 114 in 1960 (1957 - 1959 = 100.0). The Ad Hoc Water Resources Council projected dollar output per man-hour to rise from 1.70 in 1959–61 to about 14.12 in 2020.

Increased productivity per unit of labor can be expected to continue in the Basin. Basin productivity, measured by the total dollar value of farm output per employee, is projected to increase 86 percent between 1959 and 1980. From 1980 to 2000 another increase of 70 percent is expected.

The decline in farm employment coincides with increasing demand for workers in other sectors of the economy, including particularly the farm-associated industries "agribusiness". In the Basin generally, farm employment is a relatively small share of total employment. Thus, shifts which appear relatively large in farm terms are small considered in the overall labor force. A look at the low projection of unemployment rates in the economic subregions (Part II of Draft No.2, Appendix P) suggests that production demands encourage shifts to nonfarm

employment. Only in partial Economic Subregion "C" is unemployment expected to be excessive, and this could well be countered by shifts within the subregion and among subregions. Foresight in developmental planning in this area appears particularly desirable.

Employment projections by Basin plan area and economic subregion are presented in *Tables P-72* and *P-73*, respectively. Only the Big Muddy Basin, Plan Area 7, exhibits constant farm employment between 1960 and 1980. This is due to the substantial increase in agricultural production projected for this plan area. Two alternative changes could reduce employment in the Big Muddy Basin. (1) agricultural production at a level lower than projected, or (2) a sharp increase in output per employee. The first case is highly unlikely because labor consuming roughages and pasture are particularly suited to the Big Muddy soils and the associated livestock base. The second case is also unlikely because the dollar value of output per employee is already projected to increase by a substantial 137 percent between 1960 and 1980. This is higher than the average for the Basin and also higher than the projections made by the Ad Hoc Water Resources Council for the Nation as a whole. Farm employment projections for the rest of the plan areas show decreases between 1959 and 1980. This is in accordance with the faster rate of increase in productivity per worker than the rate of increase in production.

3.7.2 Basin Farm Population by Economic Subregion and by Basin Plan Areas

As with farm employment, the historic trends in farm population have also been declining. In the 1950 to 1960 decade, the Basin's farm population declined by 538 thousand, about 20 percent. Population generally follows employment, thus, these trends have resulted either from physical employment changes from area to area or from the movement of former farm employees into nonfarm activities. These trends, as was pointed out in previous paragraphs, are expected to continue. *Tables P-71* and *P-74* provide population projections by basin plan area and economic subregion, respectively.

Table P-68

Cropland Harvested and Pastureland by Basin Plan Areas, Upper Mississippi River Basin — 2000 (thousand acres)

Source: Compiled by Economic Research Service

Basin Plan Area	*Total*	*Food Grains*[a]	*Feed Grains*[b]	*Roughage Crops*[c]	*Permanent Pasture*	*Misc. Crops*[d]	*Non-harvested*[e]
1. Mississippi Headwaters	6,728	733	2,807	2,092	670	81	345
2. Chippewa and Black	3,345	321	1,677	393	713	27	214
3. Wisconsin	3,916	212	1,844	610	909	44	297
4. Rock	7,446	1,374	4,174	706	925	107	160
5. Illinois:							
5A (North)	1,727	416	1,016	111	96	66	22
5B (South)	12,365	4,184	4,769	2,260	892	93	167
6. Kaskaskia	3,206	927	740	885	630	9	15
7. Big Muddy	1,270	368	265	218	389	3	27
8. Meramec	2,525	339	336	762	874	11	203
9. Salt	3,028	533	176	935	1,248	8	128
10. Fox, Wyaconda, & Fabius	1,368	232	190	364	508	3	71
11. Des Moines	9,761	2,779	3,696	1,851	1,198	77	160
12. Skunk	2,357	695	594	901	121	15	31
13. Iowa and Cedar	7,331	1,537	3,426	1,833	409	49	77
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	4,341	348	2,853	522	545	29	44
15. Cannon, Zumbro, & Root	2,555	308	1,686	151	370	19	21
16. Minnesota	8,811	1,655	3,677	2,895	302	170	112
Total	82,080	16,961	33,926	17,489	10,799	811	2,094

[a] Includes wheat, soybeans.
[b] Includes corn, oats, barley, sorghum grain.
[c] Includes all hay, cropland pasture, corn and sorghum silage.
[d] Includes crops planted to fruit, vegetable, oil crops, and miscellaneous small grain.
[e] Includes land planted to crops and not harvested and fallow land.

Table P-69

Cropland Harvested and Pastureland by Plan Areas, First Alternative[a] Upper Mississippi River Basin — 2020 (thousand acres)

Source: Compiled by Economic Research Service

Plan Area	Total	Food Grains[b]	Feed Grains[c]	Roughage Crops[d]	Permanent Pasture	Misc. Crops[e]	Other[f]
1. Mississippi Headwaters	6,634	582	3,154	2,398	384	97	19
2. Chippewa and Black	3,343	384	1,554	792	478	34	101
3. Wisconsin	3,900	253	1,850	830	703	52	212
4. Rock	7,362	1,417	3,952	1,171	311	120	391
5. Illinois:							
5A (North)	1,161	408	482	165	24	74	8
5B (South)	12,190	4,205	3,453	2,837	441	108	1,146
6. Kaskaskia	3,197	893	448	1,487	357	11	1
7. Big Muddy	1,271	311	171	546	227	4	12
8. Meramec	2,406	278	140	1,389	585	13	1
9. Salt	3,009	353	155	1,737	755	9	
10. Fox, Wyaconda, & Fabius	1,368	191	165	740	258	3	11
11. Des Moines	9,749	2,886	3,486	2,740	397	90	150
12. Skunk	2,359	656	545	1,076	42	18	22
13. Iowa and Cedar	7,284	1,563	3,403	2,100	69	56	93
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	4,365	283	2,928	842	248	35	29
15. Cannon, Zumbro, & Root	2,548	295	1,577	430	213	22	11
16. Minnesota	8,811	1,672	3,427	3,216	197	197	102
Total	80,957	16,630	30,890	24,496	5,689	943	2,309

[a] With scarce land resources this first alternative considered a limitation of export corn.
[b] Includes wheat, soybeans.
[c] Includes corn, oats, barley, sorghum grain.
[d] Includes all hay, cropland pasture, corn and sorghum silage.
[e] Includes crops planted to fruit, vegetable, oil crops and miscellaneous small grain.
[f] Includes land planted to crops and not harvested and fallow land.

Table P-70

Cropland Harvested and Pastureland by Basin Plan Areas, Likely Alternative,[a] Upper Mississippi River Basin — 2020 (thousand acres)

Basin Plan Area	Total	Food Grains[b]	Feed Grains[c]	Roughage Crops[d]	Permanent Pasture	Misc. Crops[e]	Non-harvested[f]
1. Mississippi Headwaters	6,582	666	4,167	1,624	9	97	19
2. Chippewa and Black	3,346	488	2,236	477	9	35	101
3. Wisconsin	3,902	726	2,202	708	1	53	212
4. Rock	7,365	1,452	4,257	1,141	4	121	391
5. Illinois:							
5A (North)	1,162	327	591	161	1	74	8
5B (South)	12,191	4,264	4,444	2,212	16	108	1,146
6. Kaskaskia	3,199	1,038	566	1,534	49	11	2
7. Big Muddy	1,273	376	235	645	.2	4	12
8. Meramec	2,409	600	125	1,664	5	14	1
9. Salt	3,012	414	132	2,418	39	10	–[g]
10. Fox, Wyaconda & Fabius	1,371	114	37	1,177	27	4	12
11. Des Moines	9,751	2,651	3,379	3,328	142	90	151
12. Skunk	2,360	497	730	1,077	17	18	22
13. Iowa and Cedar	7,288	1,399	3,933	1,805	1	57	94
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	4,368	326	3,086	890	–[g]	35	30
15. Cannon, Zumbro, & Root	2,550	319	1,770	424	3	23	11
16. Minnesota	8,813	1,718	2,937	3,856	2	197	102
Total	80,942	17,375	34,827	25,151	325.2	951	2,314

[a] Uniform crop production limitation with scarce land resource.
[b] Includes wheat, soybeans.
[c] Includes corn, oats, barley, sorghum grain.
[d] Includes all hay, cropland pasture, corn and sorghum silage.
[e] Includes crops planted to fruit, vegetables, oil crops and miscellaneous small grain.
[f] Includes land planted to crops and not harvested and fallow land.
[g] Less than one thousand acres.

Table P-71

Farm Population by Basin Plan Areas, Upper Mississippi River Basin (thousands)

Plan Area	Historical			Projected		
	1940	1950	1960	1980	2000	2020
1. Mississippi Headwaters	361	292	219	145	104	93
2 Chippewa & Black	169	139	106	75	55	49
3. Wisconsin	187	153	117	78	64	59
4. Rock	262	229	197	159	113	87
5. Illinois:						
5A. (North)	147	122	80	43	23	14
5B, (South)	397	318	250	182	143	111
6. Kaskaskia	126	97	72	49	37	33
7. Big Muddy	67	51	27	25	19	17
8. Meramec	150	113	62	39	26	25
9. Salt	95	75	55	38	34	27
10. Fox, Wyaconda, & Fabius	34	27	21	18	16	13
11. Des Moines	275	233	192	141	109	96
12. Skunk	76	64	53	36	28	22
13. Iowa-Cedar	222	192	169	132	94	81
14. Turkey, Maquoketa, Wapsipin'con, & Upper Iowa	147	131	117	97	75	64
15. Cannon, Zumbro, & Root	94	81	72	61	46	38
16. Minnesota	230	197	168	128	106	96
Total	3,039	2,514	1,977	1,446	1,092	925

Table P-72

Farm Employment by Basin Plan Areas, Upper Mississippi River Basin (thousands)

Plan Area	Historical			Projected		
	1940	1950	1960	1980	2000	2020
1. Mississippi Headwaters	106	96	63	44	33	30
2. Chippewa & Black	51	48	32	24	18	17
3. Wisconsin	57	54	35	25	21	20
4. Rock	88	84	64	53	39	31
5. Illinois:						
5A (North)	50	44	29	16	9	6
5B (South)	122	108	76	59	48	38
6. Kaskaskia	36	31	19	14	11	10
7. Big Muddy	12	12	6	6	5	5
8. Meramec	39	34	18	12	8	8
9. Salt	30	25	15	11	10	8
10. Fox, Wyaconda, & Fabius	11	9	6	5	5	4
11. Des Moines	89	82	58	44	35	32
12. Skunk	25	22	16	12	9	8
13. Iowa-Cedar	77	72	54	44	32	29
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	51	48	38	32	26	23
15. Cannon, Zumbro, & Root	33	32	22	20	16	13
16. Minnesota	78	73	54	43	36	34
Total	955	874	605	464	361	316

Table P-73

Farm Employment by Economic Subregion, Upper Mississippi River Basin (thousands)

Economic Subregion	Historical			Projected		
	1940	1950	1960	1980	2000	2020
I. Minneapolis-St. Paul	152.4	141.6	98.3	70.3	51.0	42.5
A. Duluth-Superior	17.7	15.2	7.2	6.0	3.7	3.1
B. Fargo-Moorhead	22.4	21.4	15.7	13.8	10.7	8.1
C. Sioux Falls	33.0	30.3	23.5	17.9	14.6	12.6
II. Eau Claire	109.2	103.0	69.0	51.6	41.7	32.9
III. Des Moines-Ft. Dodge	157.5	145.4	105.6	84.6	66.2	61.2
IV. Rock Island-Davenport-Moline	131.5	124.0	95.1	76.5	58.8	53.1
V. Milwaukee	60.3	55.7	37.5	27.8	18.6	17.3
VI. St. Louis	101.5	139.1	81.3	61.9	50.7	45.9
VII. Peoria	92.8	82.1	58.1	44.1	37.7	32.1
VIII. Chicago	66.3	57.4	41.7	26.6	19.4	17.0
Total	1,004.6	915.2	633.0	481.1	373.1	325.8

Table P-74
Farm Population by Economic Subregion, Upper Mississippi River Basin (thousands)

Economic Subregion	Historical			Projected		
	1940	1950	1960	1980	2000	2020
I. Minneapolis-St. Paul	467.2	395.1	328.3	229.9	179.6	165.7
A. Duluth-Superior	73.6	54.2	31.6	25.2	14.8	12.1
B. Fargo-Moorhead	73.4	61.2	48.2	40.0	30.0	21.9
C. Sioux Falls	95.6	84.0	72.0	51.9	40.9	34.0
II. Eau Claire	359.2	293.0	226.3	160.2	123.6	109.9
III. Des Moines-Ft. Dodge	477.3	403.3	337.1	251.6	189.0	164.1
IV. Rock Island-Davenport-Moline	385.8	337.1	295.8	238.4	178.3	145.0
V. Milwaukee	185.5	157.3	116.0	80.3	53.7	42.5
VI. St. Louis	588.9	453.3	295.0	206.6	160.1	139.8
VII. Peoria	300.2	236.4	186.7	135.6	106.4	81.3
VIII. Chicago	207.1	173.1	126.3	79.5	53.8	41.5
Total	3,213.8	2,648.0	2,063.3	1,499.2	1,130.2	957.8

Table P-75
Land in Urbanized Areas by Basin Plan Area, Upper Mississippi River Basin — 1960, 1980, 2000 and 2020 (thousand acres)

Source: Economic Research Service

Plan Area	1960	1980	2000	2020
1. Mississippi Headwaters	822	1,041	1,274	1,423
2. Chippewa and Black	246	251	257	260
3. Wisconsin	327	345	360	376
4. Rock	392	515	642	727
5. Illinois:				
5A (North)	887	1,375	2,168	2,735
5B (South)	832	1,432	1,556	1,731
6. Kaskaskia	283	328	377	386
7. Big Muddy	113	116	117	118
8. Meramec	302	444	736	856
9. Salt	114	122	124	142
10. Fox, Wyaconda, & Fabius	50	52	53	54
11. Des Moines	445	478	502	513
12. Skunk	122	127	129	129
13. Iowa and Cedar	373	420	471	516
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	194	210	225	231
15. Cannon, Zumbro, & Root	139	211	232	240
16. Minnesota	323	394	411	412
Total	5,964	7,861	9,634	10,849

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Section 4
FOREST RESOURCES

Forestry is one of the major land uses in the Upper Mississippi River Basin. Over one-fifth of the land area of the Basin is devoted to this use. Wood is one of the major crops. The harvesting and manufacturing of timber products provides considerable employment within the region. And the importance of other forest products such as Christmas trees, furs, wildlife, and recreation is substantial.

The U.S. Forest Service of the Department of Agriculture has assumed responsibility for compiling and presenting information on the forest land and timber resources. The North Central Forest Experiment Station, which has conducted two surveys of the timber resources of most of the states in the Basin, has undertaken the task. This section of the report includes an analysis of the forest resources, their use, and resulting employment in the Basin and its economic subregions. It also includes seven tables presenting information about area, ownership, present timber volume, timber products output, and employment. Appendix N, Agriculture, and Appendix P, Economic Base Study and Projections (Draft No. 2), contain additional discussion and information concerning the significance of forest resources to the economy of the Basin.

4.1 Forest Land

Forests of the Basin include a number of major types (*Figure P-42*). The types change in response to climatic variables such as precipitation, temperature, and length of growing season and in response to soil and drainage. The forests of the Minneapolis-St. Paul, Eau Claire, Fargo-Moorhead, and Duluth-Superior subregions run largely to pine, spruce-fir, and aspen-birch types. The woodlands of the remainder of the Basin are largely oak-hickory on the uplands and elm-ash-cottonwood in the river bottoms. Pine and oak-gum-cypress types from the south have invaded southeastern Missouri.

Much of the area along the prairie margin and in Wisconsin and Illinois, once forested, has been cleared for agriculture. Most of the remaining forest has been burned over and grazed, or "mined" for the best trees. Today's forests are characterized by many cull or undesirable trees and are badly in need of forest management treatments. Even so these forests are important to the cultural and economic life of the Basin and will likely be of increasing importance to recreation and timber production.

4.1.1 Commercial Forest Land

Commercial forests cover 27½ million acres (21 percent) of land in the Basin. Two of the subregions which are among the larger in terms of land area contain over half of the commercial forest land in the Basin (*Figure P-43* and *Table P-76*). These are the Eau Claire and St. Louis subregions, each with 28 percent of the commercial forest land area in the Basin. Of the remaining subregions only the Duluth-Superior has more than 7 percent of the commercial forest land in the Basin.

The commercial forests are generally more dominant in areas with rough terrain, stony or sandy land or wet or cold soils and less dominant on the more level, warm and fertile soils. Almost three-quarters of the land are of the Duluth-Superior subregion and almost half of the land area of the Eau Claire subregion are occupied by commercial forests. On the other hand, commercial forests make up only 2 percent of the land area in the Sioux Falls subregion. Similar wide variations often occur within subregions (*Figure P-44*).

The very large increase in population by the year 2020 is expected to result in the withdrawal of considerable forest land from the commercial forest classification. Since past trends in forest land use are inadequate for estimating the commercial forest land area in the year 2020, estimates were made using the Conservation Needs Inventory and other sources. In each state, estimates were made of the reduction of commercial forest resulting from anticipated urban expansion, reservoirs and refuges, parks, private recreation, agriculture, and miscellaneous purposes, such as roads, power lines, etc.

Finally, estimates were made of the commercial forest land in the year 2020 for each state, and the percent of change since the last survey was figured. The estimated percent of change in commercial forest area ranged from a reduction of 17 in Iowa, to 14 in Illinois, to 12 in Minnesota, to 12 in Missouri, and to 4 in Wisconsin. The average reduction in the five states by the year 2020 cam to 10 percent.

While the forest acreages estimated for 2020 may not be correct, they indicate that reductions in the areas of commercial forest land may be expected. Perhaps only nine-tenths of the commercial forest land now being used to raise timber will be available in the future because of more intensive land demands for a much larger population.

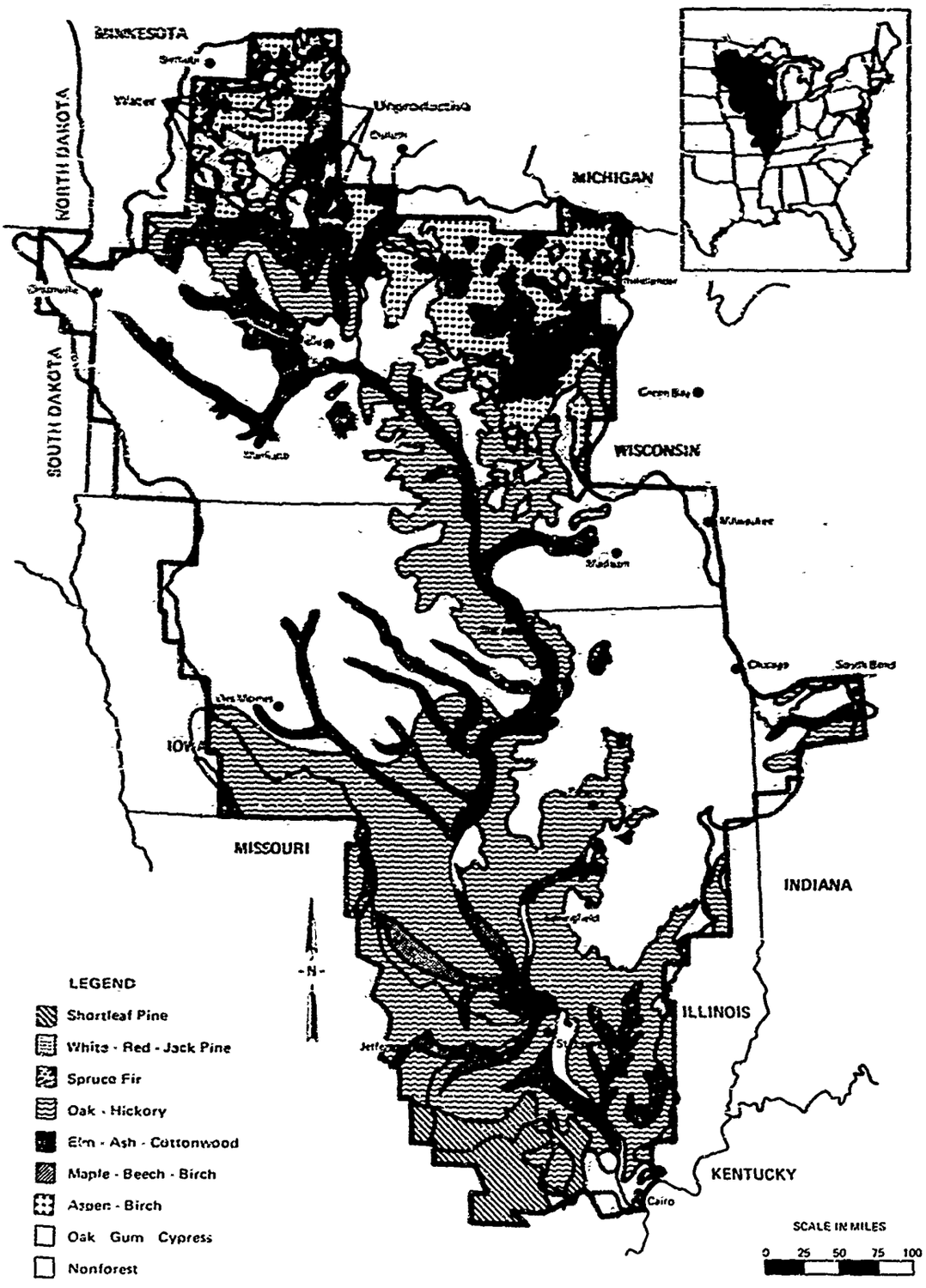


Figure P-42. Major Forest Types, Upper Mississippi River Basin.

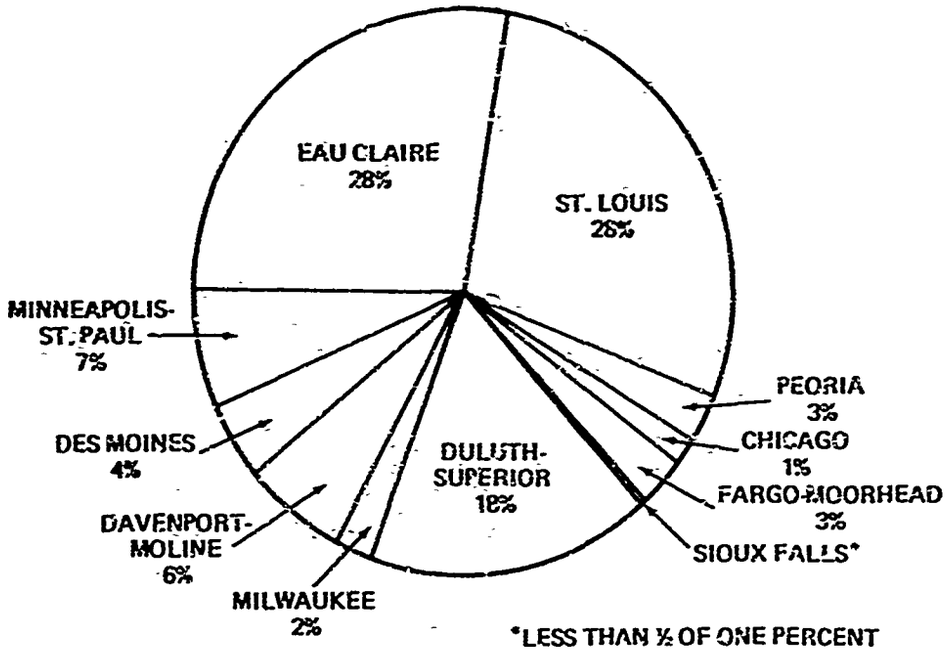


Figure P-43. Distribution of commercial forest land by economic subregions, Upper Mississippi River Basin, 1963.

Table P-76

Land Area in the Upper Mississippi River Basin by Economic Subregions and Classes of Land — January 1, 1963 (thousand acres)

Economic Subregion	*Land and Water Area*[a]			*Forest Land*			*Nonforest Land*
	Total	*Land*	*Water*	*Total*	*Commercial*	*Non-commercial*	
01 Minneapolis-St. Paul	16,498.6	16,056.2	442.4	2,096.0	1,846.7	249.3	13,960.2
02 Eau Claire	16,152.8	15,810.2	352.6	7,744.9	7,568.0	176.9	8,065.3
03 Des Moines-Ft. Dodge	18,846.8	18,818.7	28.1	1,251.6	1,239.2	12.4	17,567.1
04 Davenport-Rock Island-Moline	14,761.4	14,579.1	182.3	1,672.3	1,655.9	16.4	12,906.8
05 Milwaukee	4,984.3	4,876.8	107.5	619.6	619.6	–	4,257.2
06 St. Louis	24,894.4	24,667.6	226.8	7,907.1	7,759.0	148.1	16,760.2
07 Peoria	12,090.2	12,001.3	88.9	757.6	733.8	23.8	11,243.7
08 Chicago	7,367.0	7,326.6	40.4	396.8	388.7	8.1	6,929.8
11 Duluth-Superior	7,414.5	6,788.5	626.0	5,100.8	4,905.5	195.3	1,637.7
12 Fargo-Moorhead	3,964.0	3,791.3	172.7	809.7	775.0	34.7	2,981.6
13 Sioux Falls	4,577.9	4,543.9	34.0	68.5	64.0	4.5	4,475.4
Total	131,561.9	129,260.2	2,301.7	28,425.2	27,555.4	869.8	100,835.0

[a] From U.S. Bureau of the Census, "Land and Water Areas of the United States," 1960

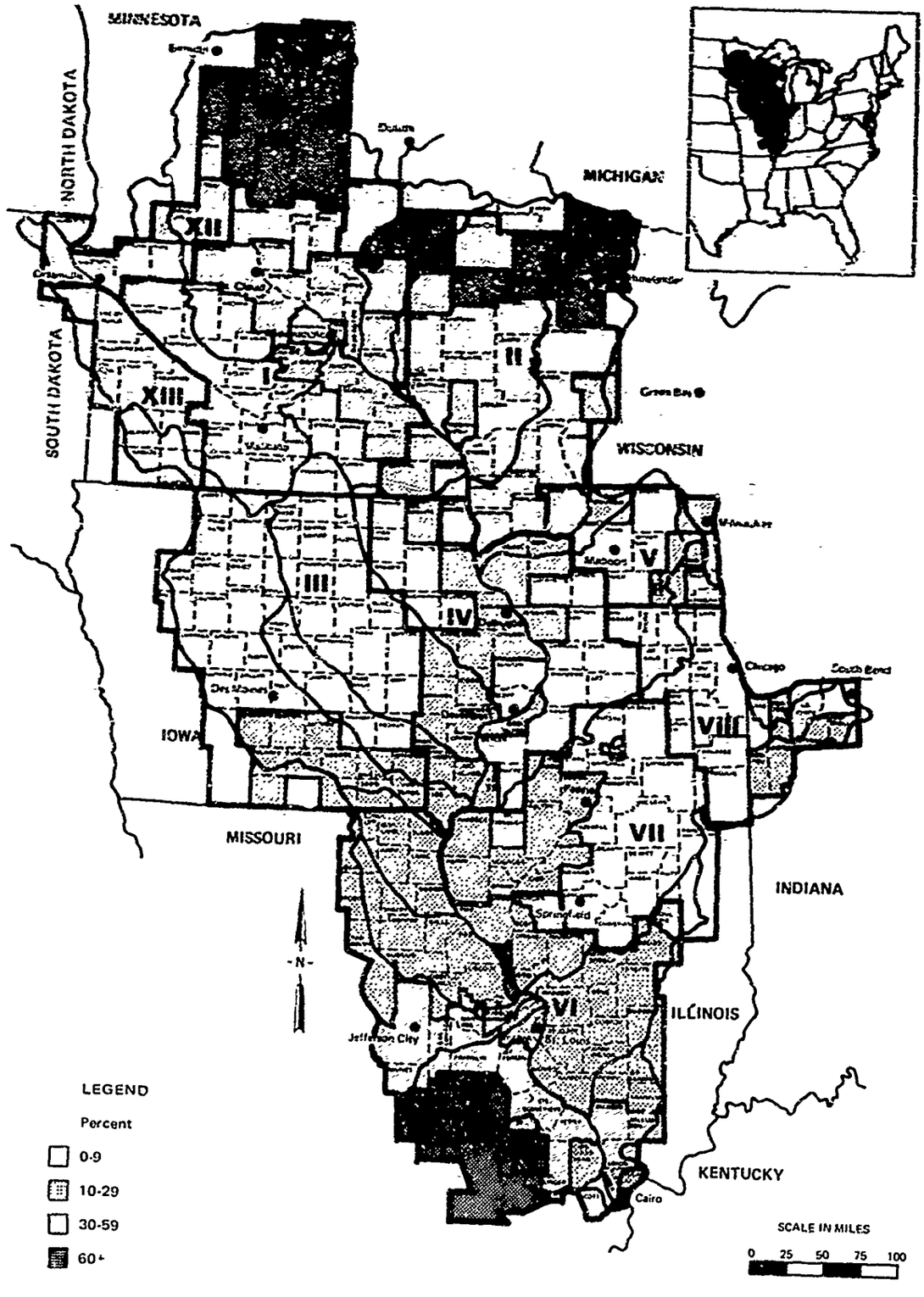


Figure P-44. Percent of land in commercial forest land by county, Upper Mississippi River Basin, 1963.

4.1.2 Ownership of Commercial Forest Land

Ownership of the commercial forest land of the Basin is predominantly by farmers and miscellaneous private owners (*Figure P-45* and *Table P-77*). Forest industry holdings amount to only 2 percent of the commercial forest area. The U.S. Forest Service controls 6 percent. other public agencies, including counties, states and other Federal Agencies, control 17 percent.

Almost all of the forest industry holdings and State and County forest are in the northern part of the Basin. National Forest lands are largely confined to the northern and southern extremes of the Basin. Farmers control most of the scattered woodlands across the central part of the region.

4.1.3 Commercial Forest Area by Timber Stand-Size

Forests are classified by timber stand size to indicate their relative development. Such classes include sawtimber, poletimber, seedlings and saplings and nonstocked areas.

The saw-timber areas usually contain enough large trees for a merchantable cut. Many of these stands must be left to put on more growth. Poletimber stands contain few sawtimber trees out are usually merchantable for the cutting of smaller timber products. Most poletimber stands should be held for additional growth. Seedling and sapling stands generally contain few timber products so that a merchantable timber cut may not be available for many years. Nonstocked areas are formerly wooded areas, now less than 10 percent stocked with forest trees but not developed for other uses. These grass and brush areas may be reproducing to trees naturally or may need tree planting to promote the growth of timber products.

In the Basin, 27 percent of the commercial forest land is occupied by sawtimber, 35 percent by poletimber, 25 percent by seedlings and saplings, and only 13 percent is nonstocked. Approximately 7½ million acres are classed sawtimber and 9-2/3 million acres are classed as poletimber.

Sawtimber stands are concentrated in the central and southern parts of the Basin with almost two-fifths of them in the St. Louis subregion. Poletimber stands are more widely distributed with about one-fourth of the Basin's total being found in each of the following: Duluth-Superior, Eau Claire, and St. Louis subregions. Young stands (seedlings and saplings) are concentrated in the northern subregions and the St. Louis subregion.

4.1.4 Stocking of Commercial Forest Land

Stocking classifications indicate the proportion of the land occupied by trees; hence, they are a measure of the utilization of the land. The stocking class "70 percent plus" is interpreted as "well stocked." The other classes are medium stocked, poorly stocked, and nonstocked.

About one-fourth of the commercial forest land in the Basin is well stocked with forest trees. These stands usually do not require any special treatment to insure growth but they may require thinning or removal of undesirable trees. One-third of the commercial forests are medium stocked. These stands usually have sufficient growing space and do not require special treatment. About one-fourth of the commercial forest land is poorly stocked. The trees in these stands may have plenty of growing space or may be competing with grass, brush, or cull trees.

The outlook for timber indicates that productive capacity of the Nation will be strained to meet timber needs by the year 2000. A favorable location and good accessibility of timber in the Basin should favor utilization of all available timber from that area.

4.2 Timber Resources

The timber inventory called growing stock is measured in cubic feet. A part of this inventory, which is large enough to be cut into merchantable logs 8 inches in diameter at the small end and 12 feet long or longer, is classed as sawtimber growing stock. It is also measured in board feet using the international one-quarter inch rule which approximates lumber scale.

While timber inventory contains all available volumes which meet certain standards, the timber growth includes only the net accrual for one year. Growth is expressed as the increment on all growing stock, and also as the increase in the sawtimber portion of the growing stock. Growth includes not only the additional volume put on merchantable trees but also the "ingrowth" of trees reaching merchantable size.

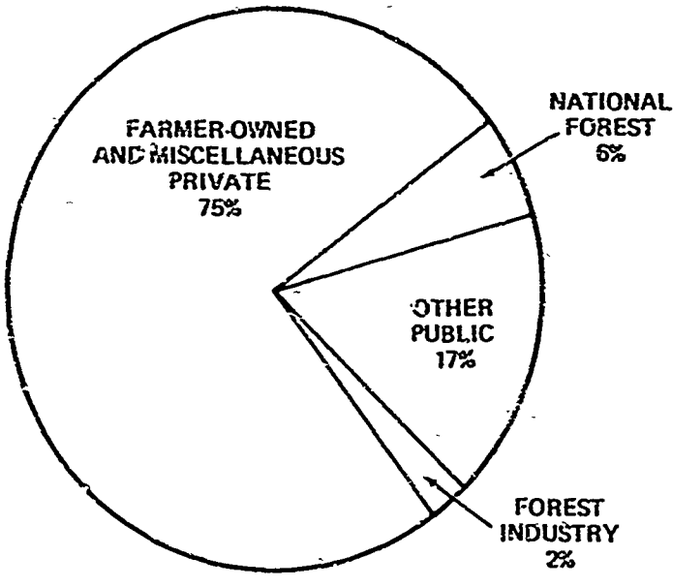


Figure P-45. Ownership of commercial forest land, Upper Mississippi River Basin, 1963.

Table P-77

Area of Commercial Forest Land in the Upper Mississippi River Basin by Economic Subregions and Ownership Classes — January 1, 1963 (thousand acres)

		Ownership Classes				
	Economic Subregion	*Total*	*National Forest*	*Other Public*	*Forest Industry*	*Farmer-Owned and Misc. Private*
01	Minneapolis-St. Paul	1,846.7	–	122.5	1.5	1,722.7
02	Eau Claire	7,568.0	367.6	1,619.0	461.9	5,119.5
03	Des Moines	1,239.2	1.8	15.4	–	1,222.0
04	Davenport-Rock Island-Moline	1,655.9	.5	33.1	1.0	1,621.3
05	Milwaukee	619.6	–	25.5	–	594.1
06	St. Louis	7,759.0	732.7	143.0	7.7	6,875.6
07	Peoria	733.8	–	13.2	2.9	717.7
08	Chicago	388.7	–	7.7	.6	380.4
11	Duluth-Superior	4,905.5	515.3	2,321.5	119.5	1,949.2
12	Fargo-Moorhead	775.0	–	262.4	35.7	476.9
13	Sioux Falls	64.0	–	–	–	64.0
	Total	27,555.4	1,617.9	4,563.3	630.8	20,743.4

4.2.1 Timber Volume

The growing stock volumes of the Basin total 14¾ billion cubic feet, which is about 517 cubic feet (6½ cords) per acre (*Table P-78*). Nearly 8 billion cubic feet or 56 percent of this growing stock volume is in poletimber-size trees. Forty-four percent is in sawtimber-size trees. Under a long time forest management program, the volume per acre should be about doubled and the proportion in sawtimber-size trees should increase considerably.

Over half of the growing stock in the Basin is in the Eau Claire, St. Louis and Duluth-Superior subregions (*Figure P-46*). The large differences in volume of growing stock by subregions are mainly due to the substantial variations in forest acreage. Volume per acre varies only from about 5.8 to 8.3 cords in the various subregions.

Sawtimber volume in the Basin totals 35.8 billion board feet and averages 1,300 board feet per acre of commercial forest land. Three quarters of this volume is in sawtimber stands. The remaining 25 percent is in poletimber or restocking stands.

The board foot volume per acre of sawtimber stands is a better indication of the stand situation than the board foot volume per acre on all commercial forest land. For the entire Basin this figure is 3,600 board feet per acre but it varies from 2,600 to 5,300 board feet in the several subregions.

The distribution of sawtimber by subregions is parallel to that for cubic feet volumes in that Eau Claire, St. Louis and Duluth-Superior contain the largest volumes. Distribution differs in that sawtimber makes up a smaller portion of the growing stock in the northern cutover forests and a larger proportion of the growing stock in other subregions. This is well illustrated by the board foot-cubic foot ratio which is an index to size of trees. In the northern cutover areas, the board foot-cubic foot ratio runs from about 1.5 to 1.9. The Minneapolis-St. Paul and St. Louis subregions contain enough small timber so their board foot-cubic foot ratios are about 3.0. In other subregions, the board foot-cubic foot ratio ranges from 3.3 to 4.9 compared to the Basin average of 2.5.

Hardwoods make up 88 percent of both the growing stock and sawtimber volume, and softwoods only 12 percent. Two species groups, the select white and red oak and "other hardwoods," each make up one-quarter of the growing stock volumes. The select white and red oak and the other hardwoods groups each make up 31 percent of the total sawtimber volume. A comparison of the sawtimber and poletimber volumes indicates the trends in species distribution (*Figure P-47*). While the volumes of the larger trees now run heavily to select red and white oaks, the volume of the smaller trees (poletimber) indicates a much smaller volume of the select oaks. The volume of cottonwood and aspen appears to be increasing very rapidly and the volume of hard maple seems to be decreasing somewhat. Each of the other species groups is maintaining its approximate level.

4.2.2 Timber Ownership

Ownership is a key factor in assessing forest inventory trends and the outlook for the timber supply. The larger public and private owners tend to bring more skill into management of their forest land. While some small owners may do an outstanding job, the great majority lack incentive or skill along this line. The small size of most holdings results in infrequent returns and difficult problems of management. Good markets are often lacking for timber from woodlot forests because only small and irregular lots of forest products are typically available or low quality timber predominates. Many owners are unfamiliar with forest opportunities and procedures or lack the capital necessary for stand improvement, planting and carrying charges, or are uninterested in timber growing.

Seventy-five percent of the growing stock and 81 percent of the sawtimber volumes in the Basin are in farmer and miscellaneous private ownership. Forest industry holds only 2 percent of the growing stock. Public owners hold 23 percent of the growing stock with 6 percent under National Forest Administration.

The farmer and miscellaneous private ownership group is dominant in every subregion in the Basin except in Duluth-Superior where it includes only 40 percent of the growing stock volumes (*Figure P-48*). The "other public ownership" (former tax delinquent lands) of growing stock volume is low in most subregions but does reach 47 percent in the Duluth-Superior area. National Forest ownership of growing stock is confined primarily to the Duluth-Superior, St. Louis, and Eau Claire subregions with 11, 9, and 5 percent, respectively. Forest industry ownership of growing stock volumes is very small, although it does reach 6 percent in Eau Claire and 5 percent in the Fargo-Moorhead subregions.

4.2.3 Timber Quality

The quality of sawtimber volume is estimated by classifying trees or logs into three standard factory log grades and tie and timber logs. The highest quality group (factory log grade number one) includes only 8 percent of the hardwood sawtimber volume in the entire basin. Fourteen percent of the hardwood sawtimber volume is in log grade two and 78 percent is in the factory log grade three and tie and timber group.

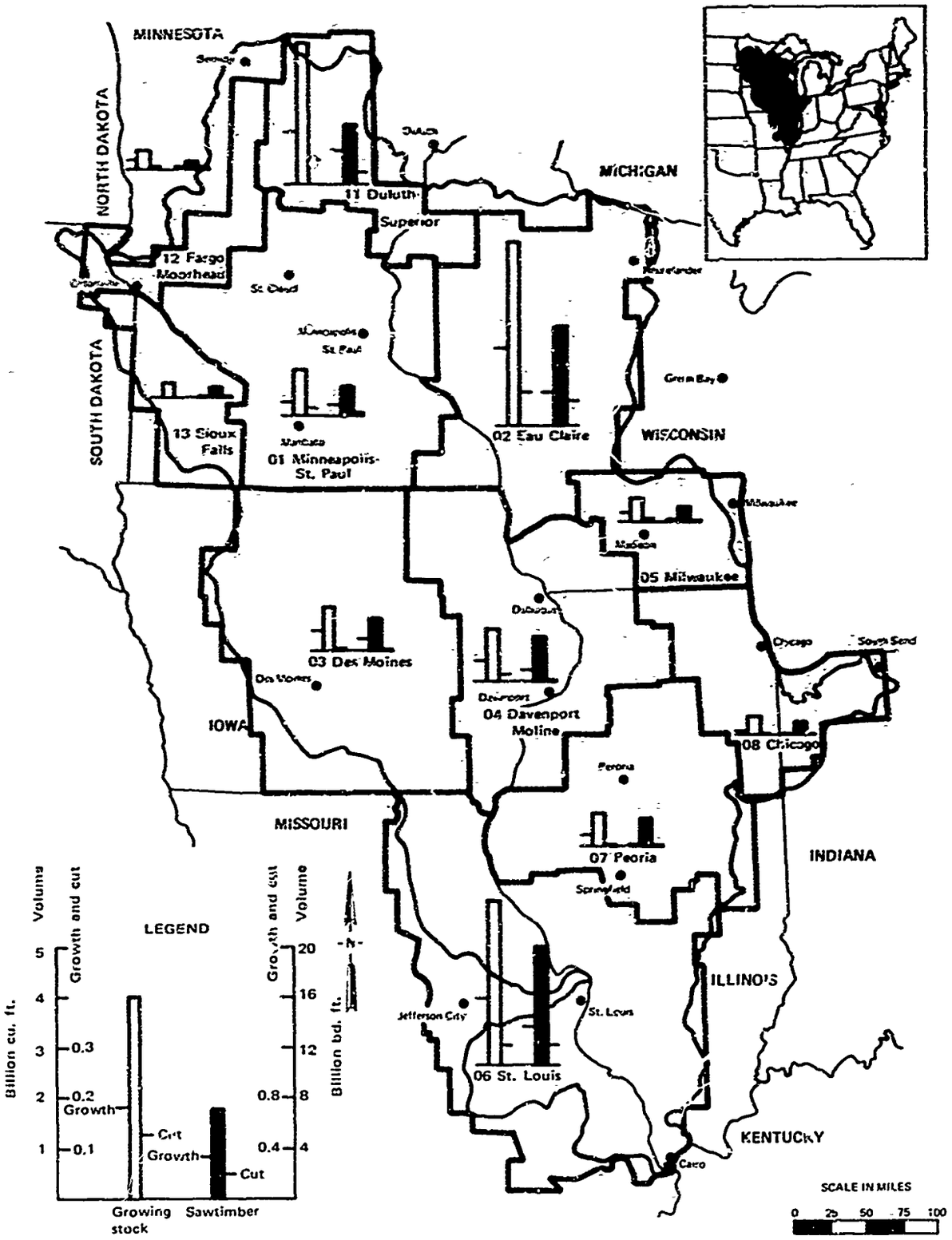
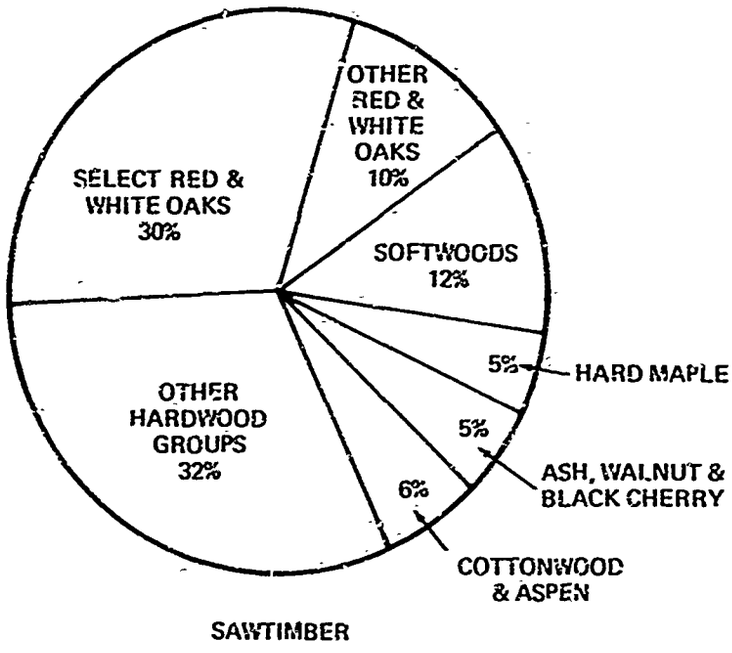
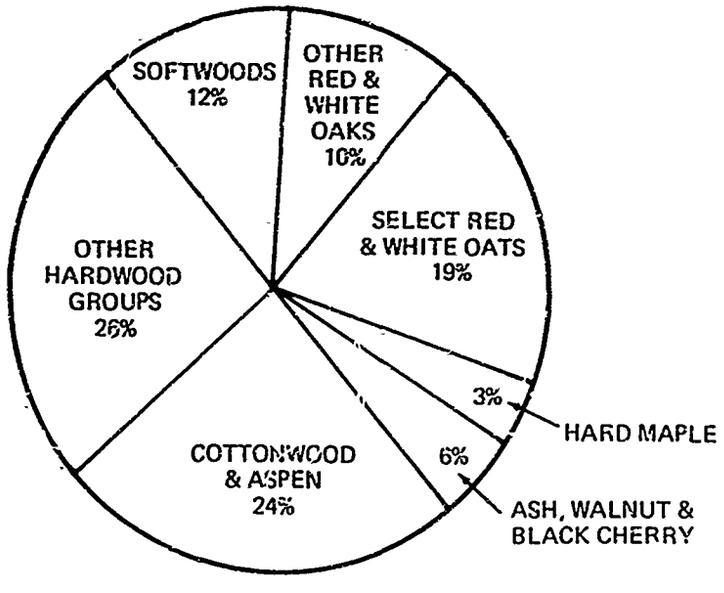


Figure P-46. Comparison of growing stock and sawtimber volumes with annual growth and annual cut by subregions, Upper Mississippi River Basin, 1963.
Growth-cut levels on the left and right sides of the columns, respectively, exaggerate growth and cut 10 times with respect to volume and provide comparison with one another.



SAWTIMBER



POLETIMBER

Figure P-47. Distribution of sawtimber and poletimber volumes by species, Upper Mississippi River Basin, 1963.

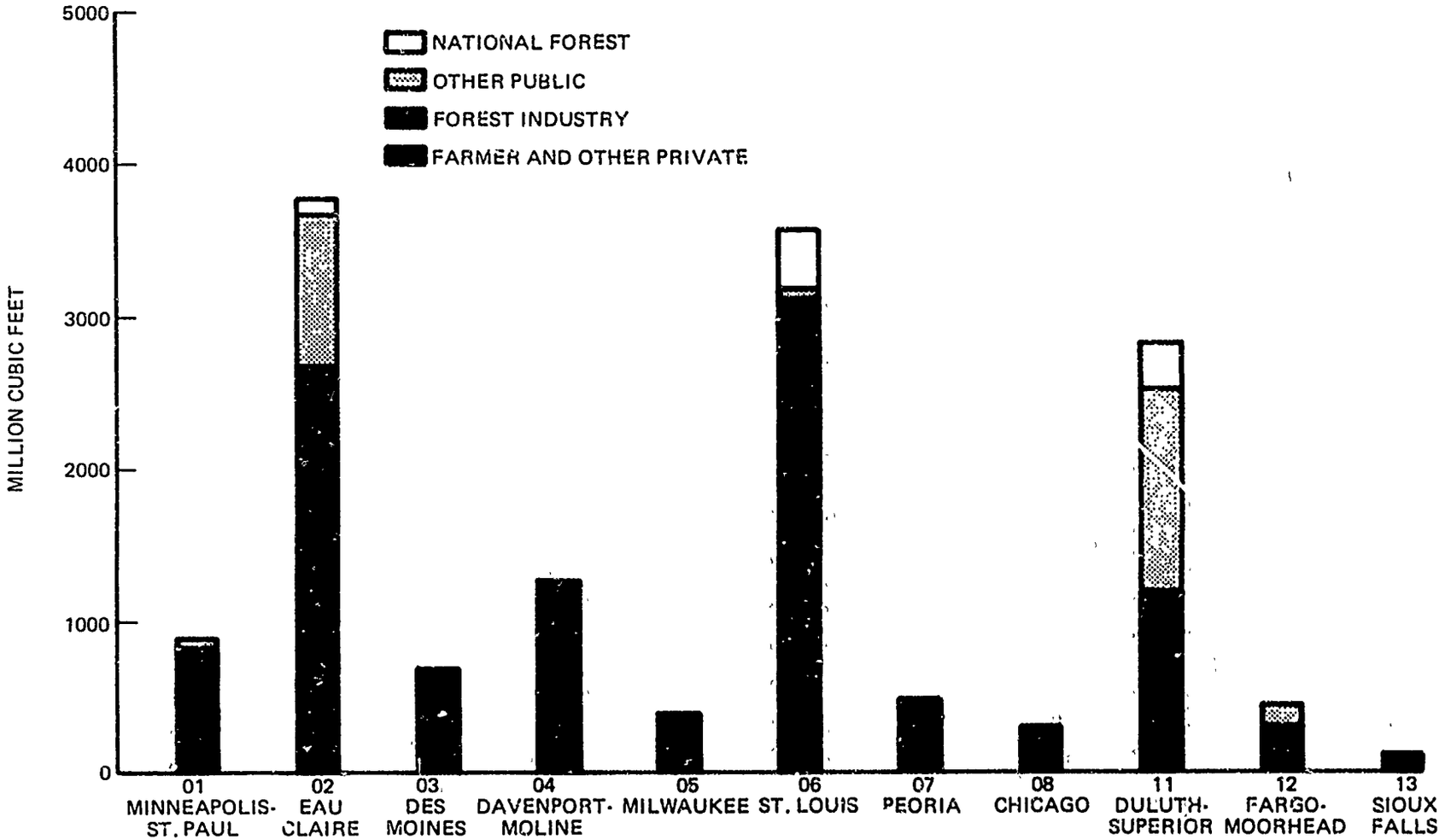


Figure P-48. Distribution of growing stock volume by ownership in each economic subregion, Upper Mississippi River Basin, 1963.

Only 4 percent of the sawtimber volume of select red and white oaks in the Basin qualifies as number one grade, while 85 percent falls in the number three log grade (*Figure P-49*). Almost one-half of the log grade one sawtimber is in the "other hardwoods" species group.

Tree and log size are very significant in determining log grade since few trees less than 15 inches in diameter at breast height contain grade one or two logs. About half of the sawtimber volume in the Basin is in trees less than 15 inches in diameter (*Figure P-50*). About one-fourth of the sawtimber volume is in the 16- and 18-inch diameter classes and the remaining one-fifth is larger. The proportion of sawtimber volume in trees less than 15 inches in diameter, by species, ranges around 51 percent. More of the "other hardwoods" sawtimber volume is in larger size trees and more of the hickory and ash, walnut, and black cherry groups are in smaller trees.

4.2.4 Timber Growth

The net annual growth in the Basin amounts to 537 million cubic feet, which is approximately 20 cubic feet or one-quarter of a cord per acre of commercial forest land (*Figure P-51*). This is an annual growth rate of 3.8 percent of the growing stock volume. The net annual growth of sawtimber in the Basin is about 1.3 billion board feet which comes to 49 board feet per acre of commercial forest land. This is an annual growth rate of 3.8 percent of the sawtimber growing stock.

Percentagewise, the growth of growing stock and sawtimber in the Basin was satisfactory considering the high mortality due to drought and diseases of the oaks and elms. Growth rates are based on the previous decades average diameter and height increments, reduced by the average natural mortality for the decade. Net growth rates were best in the relatively young stands of the northern and southern extremes of the Basin and poorer in the relatively older forests of the mid-section (*Figure P-46*). Since growth is exaggerated 10 times in the figure, one-half of each column indicates 5 percent growth.

The net annual growth per acre was unsatisfactorily low considering the preponderance of fast growing species in the north and the rich soils, usually adequate precipitation, and long growing season in the south.

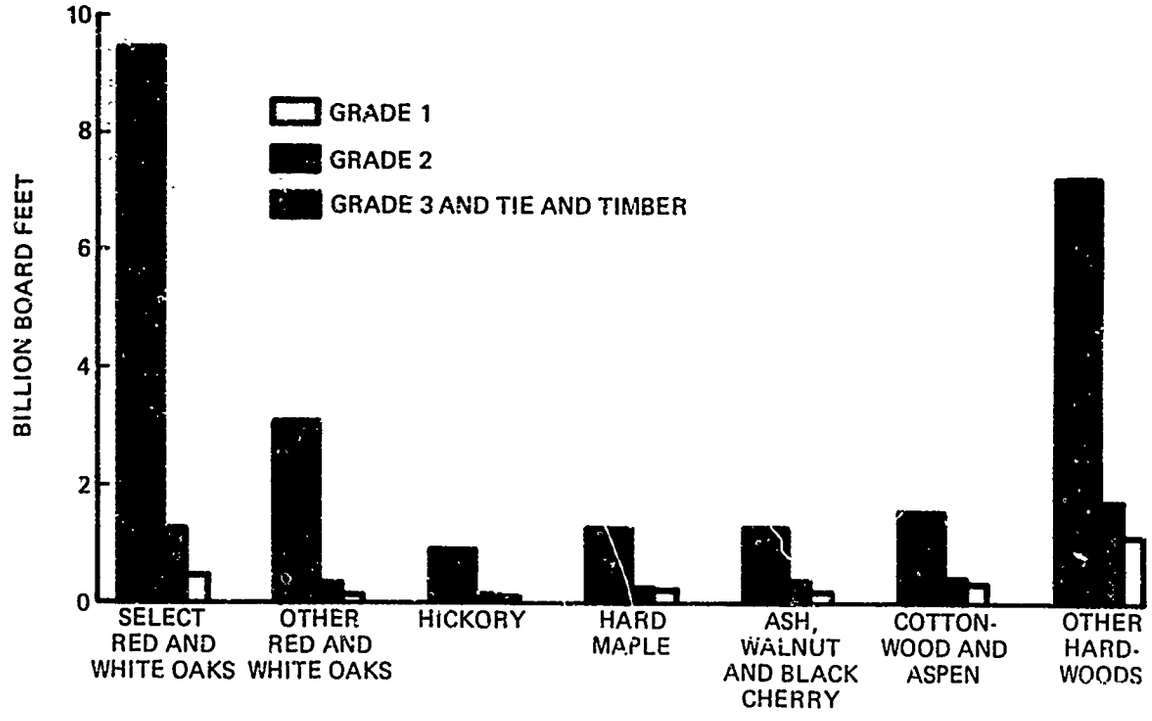


Figure P-49. Sawtimber volumes by species groups and factory log grades, Upper Mississippi River Basin, 1963.

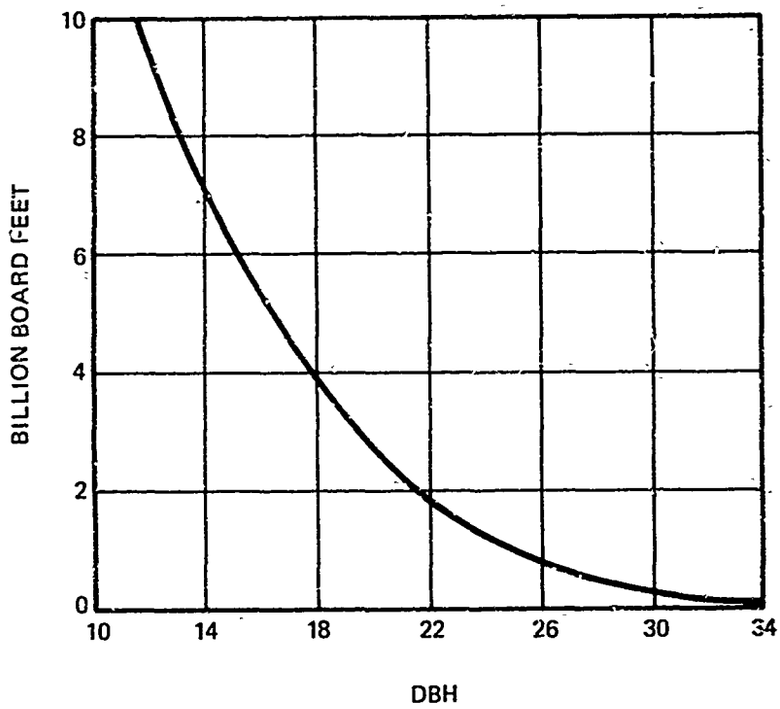


Figure P-50. Distribution of sawtimber volume by diameter classes, Upper Mississippi River Basin, 1963.

If timber volume is built up, growth will increase. In 1962, the growing stock volume per acre of commercial forest land was only 1,400 board feet. For maximum growth timber volume per acre should be 2 or 3 times greater.

The net annual growth of all growing stock is heavily concentrated in the select oaks, cottonwood and aspen, and "other hardwoods" groups. The annual growth of sawtimber, on the other hand, is concentrated in the select oaks and "other hardwoods" (*Figure P-51*). Little of the aspen growing stock has reached sawtimber size.

4.3 Production From Forest Land and Demand For Products, 1952, 1962 and Projections to 2020

4.3.1 Timber Products Output

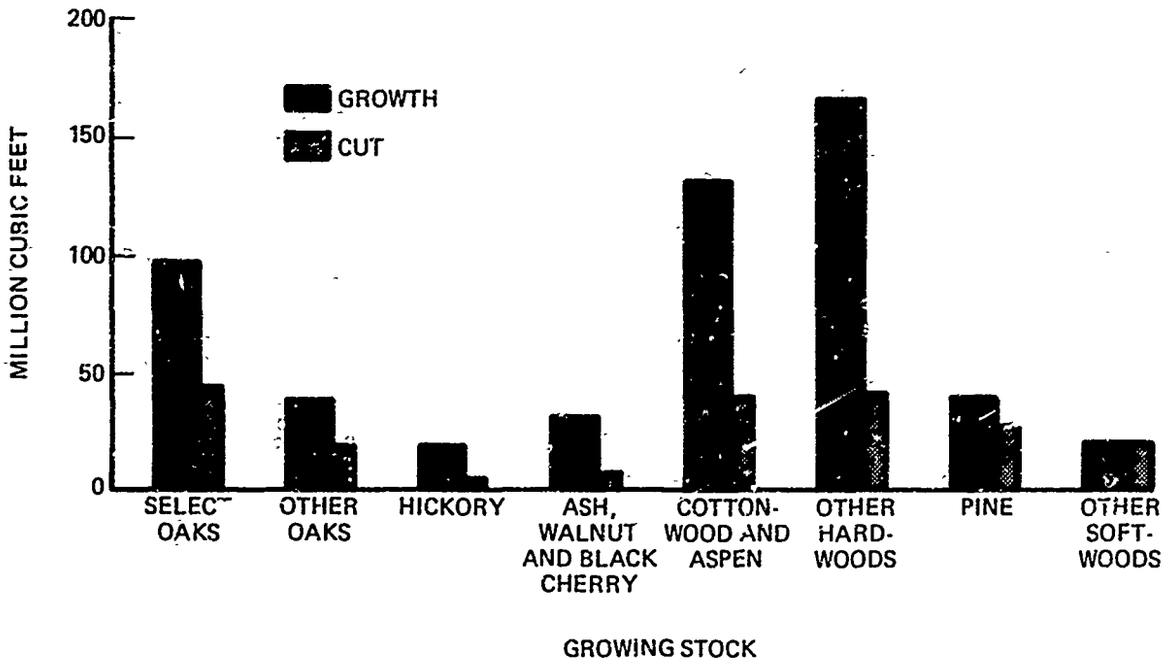
As shown in *Table P-79* projections of timber products output were made for three major products groups: (1) saw logs, veneer logs, and minor industrial products, (2) pulpwood, and (3) fuelwood (*Figure P-52*).

While most of the cut in the forest group is for saw logs and saw bolts, it also includes veneer logs, cooperage logs, handle stock, mine timbers, poles, posts, and miscellaneous industrial wood products. Output for the Basin showed a reduction from 1952 and 1962, following the trend found in the five northern economic subregions. In the six southern subregions output of these products increased during the period. After 1962, the output of these products is expected to increase rapidly in all subregions but to increase much more rapidly in the northern ones than in the southern ones. By 2020 the output is estimated to be approximately 4 times the output for 1962.

The output of pulpwood has been increasing and is expected to increase at about the same rate until the year 2020, when it will be about 2½ times the 1962 output. The greatest rates of increase will be in the southern subregions.

The output of fuelwood has declined for some years. This trend is expected to continue but to level off before the year 2020.

A study of economic growth in the United States and resulting timber demands indicates that the demand for timber products may be expected to increase about 80 percent by the year 2000. While the consumption of fuelwood is expected to drop, the demands for industrial wood products will rise. Major expansions in population and the economy will require some 21.3 billion cubic feet in 2000. Imports of timber products are expected to



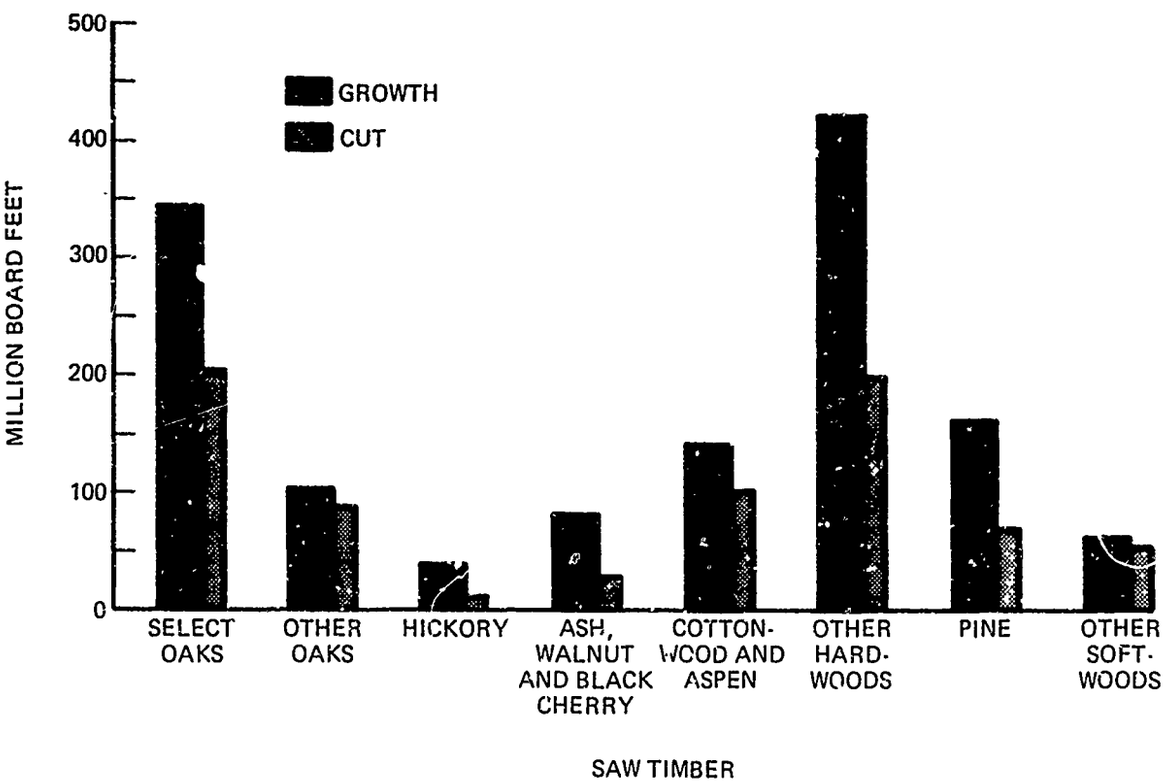


Figure P-51. Comparison of net annual growth and annual cut of growing stock and sawtimber by species groups, Upper Mississippi River Basin, 1962.

Table P-78

Volume of Growing Stock and Sawtimber on Commercial Forest Land in the Upper Mississippi River Basin by Economic Subregion and Hardwoods and Softwoods -- 1963[a]

Economic Subregion	Growing Stock Volume, MM cubic feet[b]									Sawtimber, MM board feet[c]		
	Total			Poletimber			Sawtimber					
	Total	Hardwoods	Softwoods	Total	Hardwoods	Softwoods	Total	Hardwoods	Softwoods	Total	Hardwoods	Softwoods
01 Minneapolis-St. Paul	842	505	37	429	410	19	413	395	18	2,592	2,500	92
02 Eau Claire	3,822	3,323	499	2,493	2,264	229	1,329	1,059	270	7,312	5,904	1 408
03 Des Moines-Ft. Dodge	688	687	1	176	175	1	512	512	–	2,518	2,516	2
04 Davenport-Rock Island-Moline	1,095	1,089	6	319	317	2	776	772	4	4,043	4,022	21
05 Milwaukee	361	354	7	174	170	4	187	184	3	1,207	1,191	16
06 St. Louis	3,538	3,347	191	1,720	1,628	92	1,818	1,719	99	9,859	9,421	438
07 Peoria	421	421	–	142	142	–	279	279	–	1,590	1,590	–
08 Chicago	254	254	–	66	66	–	188	188	–	1,236	1,236	–
11 Duluth-Superior	2,836	1,992	844	2,094	1,585	509	742	407	335	4,769	2,448	2,321
12 Fargo-Moorhead	364	252	112	285	203	82	79	49	30	552	317	235
13 Sioux Falls	36	36	–	9	9	–	27	27	–	170	170	–
Basin Total	14,257	12,560	1,697	7,907	6,969	938	6,350	5,591	759	35,848	31,315	4,533

[a] From "Forest Resource Statistics for the Upper Mississippi River Basin," Table 5, Forest Service, in Part IV, UMRCBS, Appendix P, Draft No. 2.

[b] Growing stock includes the cubic foot volume of all merchantable live trees 5.0" d.b.h. and over.

[c] Includes board foot volume of growing stock trees in sawtimber size only (hardwoods 11.0" d.b.h. and over, softwoods 9.0" d.b.h. and over.)

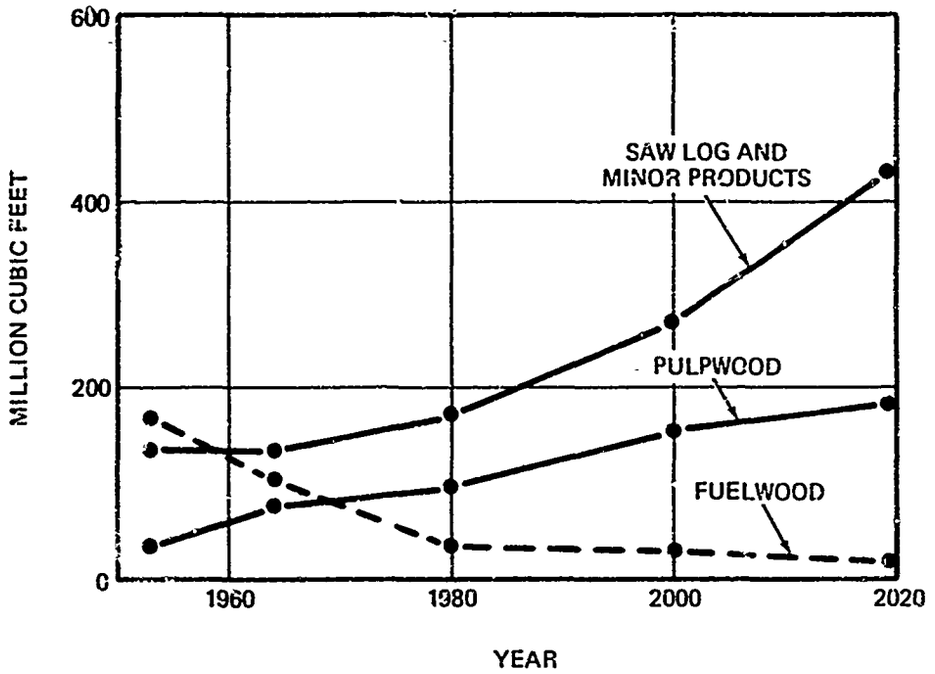


Figure P-52. Projection of timber products output by major groups, Upper Mississippi River Basin.

increase, but most of the timber required to supply U.S. markets will be from domestic forests. The national timber supply-demand relationship has improved in recent years and prospective timber growth seems adequate to meet projected demands for the next several decades. The timber supply of small and low grade materials is favorable for a longer period. This is not the case for lumber and higher quality forest products. By the year 2000 sawtimber demands will be difficult to meet without more intensive forest management and utilization.

From the foregoing it may be concluded that markets for both pulp and solid wood products in the Basin will grow. The demand will increase with the expanding population in and near the Basin. The forest industry will expand in order to better utilize the available supply of timber. The trend will probably be an early, rapid sustained increase in the use of pulpwood and a delayed and slower advance in the cut of larger logs for higher quality products from more desirable species.

4.3.2 Timber Cut

The timber cut from growing stock amounts to 199 million cubic feet and from sawtimber 739 million board feet. The cut of growing stock was only 7 cubic feet per acre of commercial forest land. This included the sawtimber cut of 27 board feet per acre. Both are considerably lower than the net annual growth of 20 cubic feet of growing stock including 49 board feet of sawtimber per acre.

The timber cut of growing stock was 1.4 percent of the growing stock inventory of the Basin, and of sawtimber, 2.1 percent of the sawtimber inventory of the Basin. Thirty-seven percent of the growth in cubic feet and 55 percent of the growth in board feet was cut in 1962. Although the proportions varied somewhat the same situation held in each of the subregions (*Figure P-46*).

Basinwise, the timber cut runs heavily to the select oaks, cottonwood and aspen, and "other hardwoods" (*Figure P-51*). Comparisons of the growth and cut of growing stock by species groups indicates that growth is two to three times the present cut except for the "other softwood" group whose cut equals growth. Specieswise, the cut of sawtimber is very similar. The excess of growth over cut is not so prominent for sawtimber, but growth exceeds cut in every species group (*Figure P-51*). The forest resource is undergoing a very rapid buildup from a very low timber capital base. Timber surpluses are available now, particularly for small, low quality products.

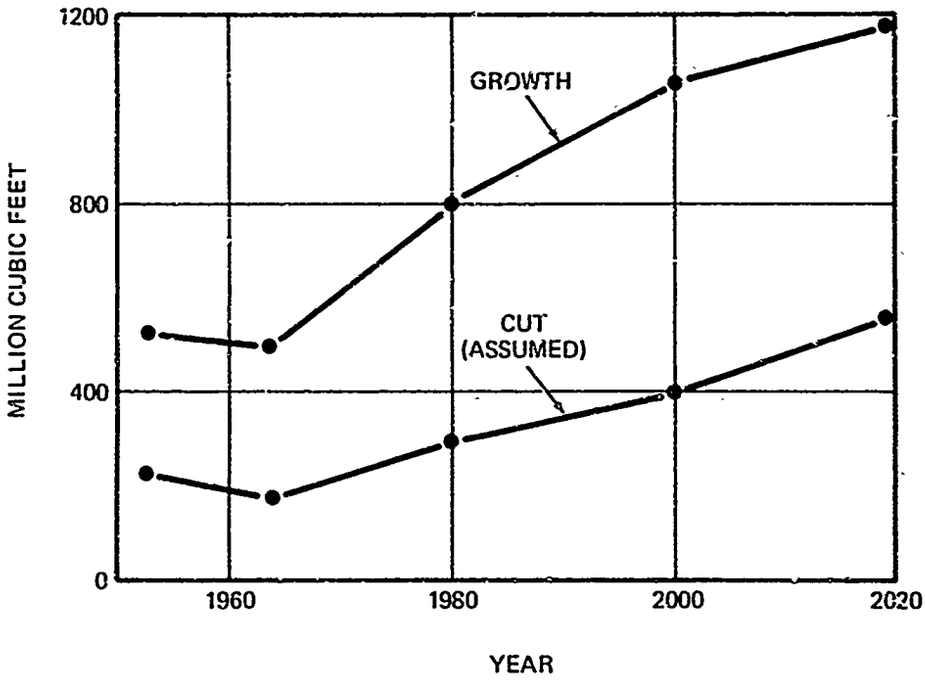


Figure P-53. Projections of cut and growth of growing stock, Upper Mississippi River Basin.

4.3.3 Trends in Timber Cut and Growth

The cut of growing stock in the Basin decreased from 221 million cubic feet in 1952 to 199 million cubic feet in 1962 (*Figure P-53*). If timber products output increases as anticipated, the cut must soon rise, reversing the downward trend. It will climb to an estimated 566 million cubic feet by the year 2020. Similar changes are projected for timber growth with growth increasing somewhat more than cut by the year 2020. By 2020, growing stock volume is expected to be 3 times that of 1962. Despite higher demand, the assumed cut is expected to fall farther below growth than at present.

The sawtimber cut in the Basin is expected to rise from 703 million board feet in 1962 to 1,520 million board feet in 2020 (*Figure P-54*). Growth shows an unusual drop from 1952 to 1962, probably due to a severe drought and the dutch elm and oak wilt diseases. It is expected to rise from 1,350 million board feet in 1962 to 2,240 million board feet in 2020 when the assumed cut is expected to equal two-thirds of the sawtimber growth. The sawtimber inventory is estimated to more than double during the period.

The size of the average tree in the inventory and of timber being grown and cut is indicated by the board foot, cubic foot ratio. Larger ratios indicate larger trees. Normally more larger trees are cut, hence, the ratio for cut is higher than for growth or inventory. Usually growth rates are highest for younger trees. hence, this ration is smaller for growth than for cut or inventory. The cutover areas of the northern Lake States show lower board foot-cubic foot ratios (1.5 to 3.1) than the areas farther south (2.8 to 4.9). If the assumed cut is made, the average size of timber in the inventory will decrease from 2.5 in 1962 to 1.8 in 2020, and a smaller portion of the timber cut will come from large trees in the future than at present. Since the total cut will be greater, the actual cut of high grade material may be more than now. There will be greater opportunity for expanding production from small, low grade materials resulting from improvement cuttings than for increasing output of high quality products.

4.4 Employment in Forest Products Industries, 1952, 1962 and Projections to 2020

The distribution of major forest product industries is shown in *Figure P-56*. Additional small primary or secondary wood-using industries are located in almost every County.

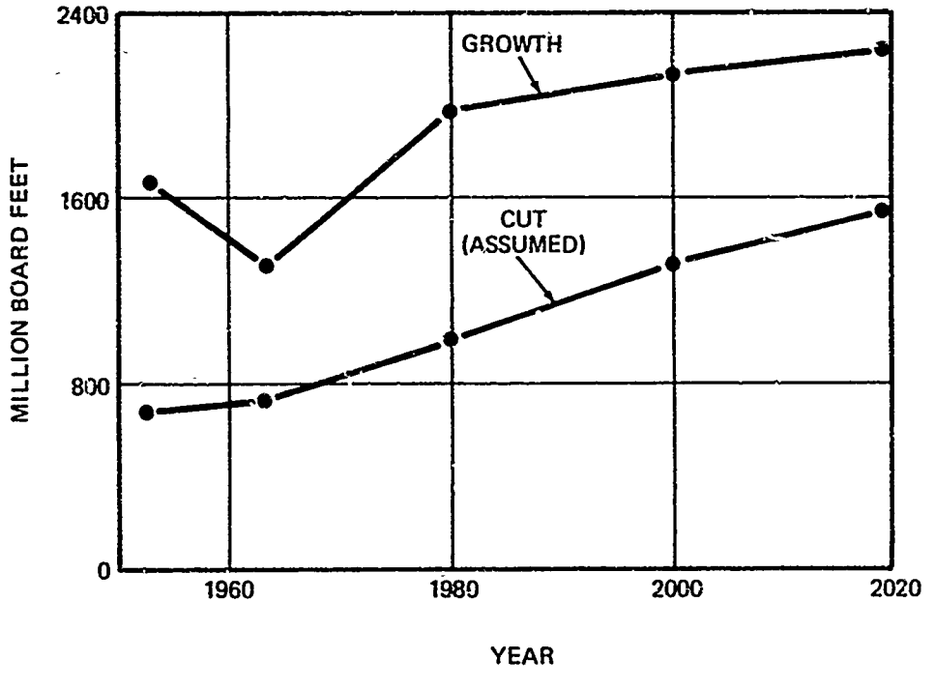


Figure P-54. Projections of cut and growth of sawtimber, Upper Mississippi River Basin.

In 1952, some 99 thousand persons were employed in these timber based industries of the Basin (*Table P-80*).* These estimates are based on census records which, in the case of manufacturing plants coming under SIC group 24, were adjusted upward to include employment in small mills. These estimates include timber harvesting, but do not include employment in forest management and protection, nor do they include all secondary manufacturing of timber products. About 54 percent of the 1952 employment was involved in the manufacture of pulp, paper, and allied products. Timber harvesting employed 19 percent and saw and planing mills less than 7 percent of the number of employees.

By 1962, the timber based employment had risen to 110 thousand employees. Employment increased in each category except in timber harvesting where greater productivity had taken place, and in saw and planing mills where many inefficient mills had quit operating (*Figure P-55*).

As shown in *Table P-80* projected employment in timber based industries of the Basin is expected to be 227 thousand persons by 2020.

*Persons as used here refers to man-years of employment. In 1952 and 1962 a man year of employment amounted to 2,000 man-hours. In anticipation of a shorter man week, a 1,300 man-hour year was used for 1980 and later periods. Large increases in the productivity of labor are expected to take place because of new technology. However, the figures in *Tables P-78* and *P-79* cannot be used satisfactorily for measuring this change since *Table P-78* presents information of timber products output from the Basin while *Table P-80* indicates the employment involved in all manufacture of forest based industries in this area. Imports, particularly of pulpwood, into the Basin are large enough to make considerable error in comparing the figures from the two tables. Recognizing these differences and using a constant 2,000 hour man year, we find our productivity increases for pulp and allied paper products from 1952 to 1962 to be 3.2 percent compounded, from 1962 to 1980 3.1 percent, from 1980 to the year 2000, 1.8 percent compounded, and for 2000 to 2020, 1.2 percent. For saw logs and other products we find a productivity decrease from 1952 to 1962 and a productivity increase of 4.0 and 2.4 and 1.9 for later periods.

A comparison of productivity in Minnesota and the North Central Region with that for the Nation shows that this area has a good deal of catching up to do to remain competitive. For the period 1952 and 1962 the increase for the Nation was 3.8 percent, for the North Central Region, 1.6 percent, and for Minnesota (1958 to 1964), 1.4 percent compounded.

Timber harvesting in 1962 made up about one-seventh of the employment attributed to forest-based industries. It is expected to provide work for about 36 thousand persons in 2020. In 1962 about 6 thousand persons were employed in sawmills and planing mills, 64 thousand in pulp, paper and allied products, and 23 thousand in other primary manufacturing wood-using industries. By the year 2020 these figures are expected to rise to 15 thousand for the sawmill group, 132 thousand for the pulp and paper mill group, and 44 thousand for the "other" group. Expected increases over 1962 employment by the year 2020 are 227 percent for sawmills, 206 percent for pulp and paper mills, and 191 percent for "other" plants.

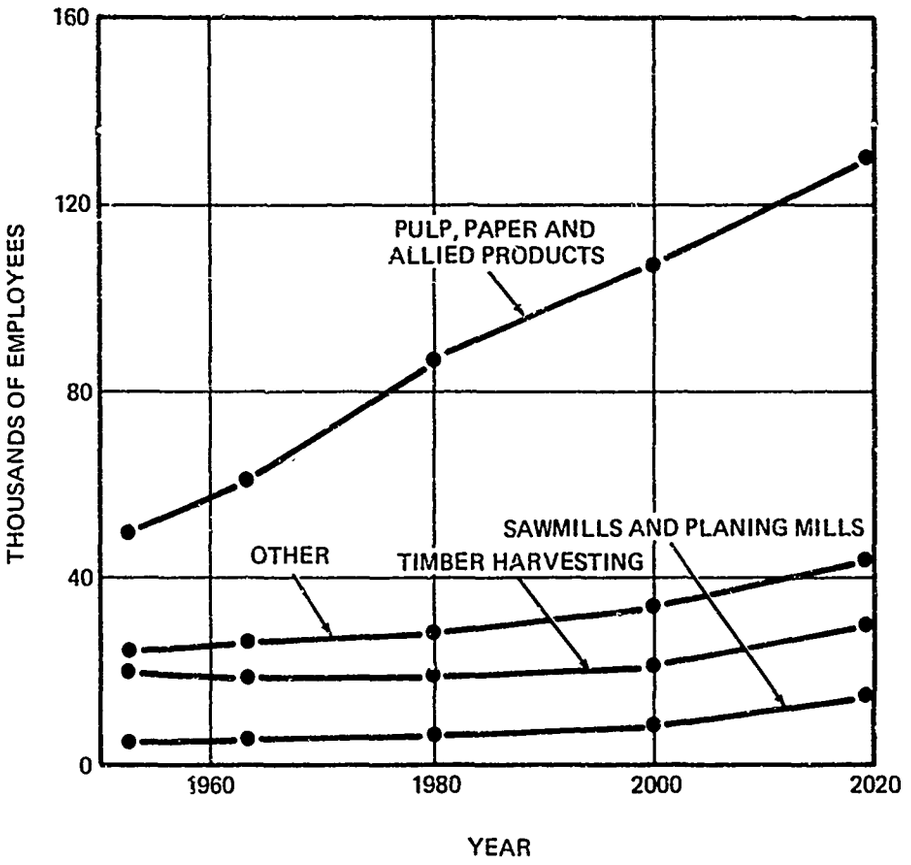


Figure P-55. Projections of employment in timber-based industries, Upper Mississippi River Basin.

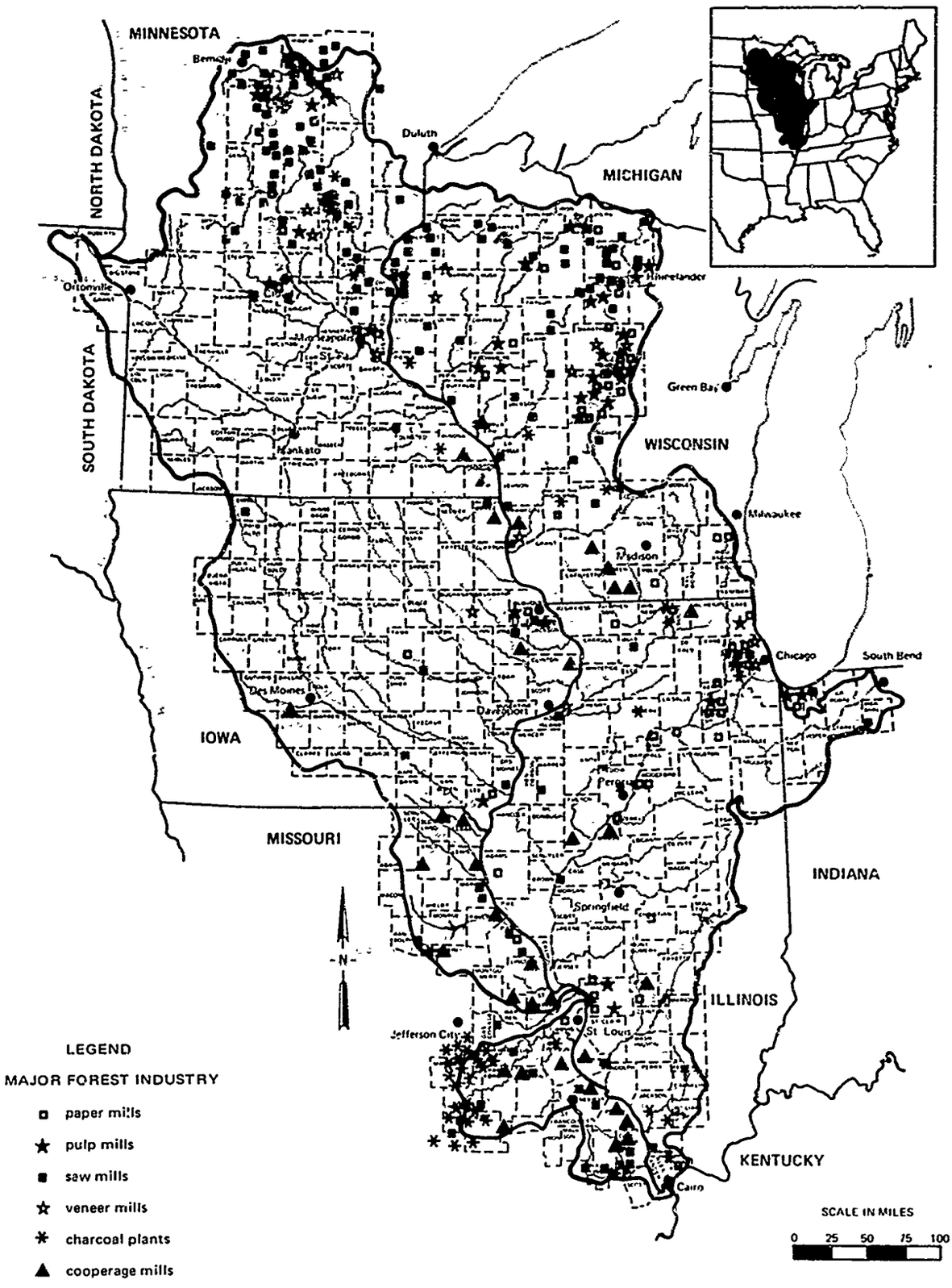


Figure P-56. Major forest industry, Upper Mississippi River Basin.

Table P-79

Timber Products Output in the Upper Mississippi River Basin by Economic Subregion -- 1952 and 1962, and Projections -- 1980, 2000, and 2020[a]

Economic Subregion	*Sawlogs, Veneer Logs and Minor Industrial Products, million cubic feet*[b]					*Pulpwood, thousand cords*					*Fuelwood, thousand cords*				
	1952	*1962*	*1980*	*2000*	*2020*	*1952*	*1962*	*1980*	*2000*	*2020*	*1952*	*1962*	*1980*	*2000*	*2020*
01 Minneapolis-St. Paul	6.7	4.9	12.0	16.9	24.5	38	46	63	91	113	130	84	32	22	20
02 Eau Claire	35.0	32.0	48.1	59.6	80.7	261	521	784	1,080	1,227	553	370	151	105	93
03 Des Moines-Ft. Dodge	3.6	4.1	6.9	13.9	24.3	1	10	23	33	44	132	73	51	44	39
04 Davenport-Rock Island-Moline	5.7	7.0	11.8	23.2	42.0	4	20	40	58	73	100	113	72	62	56
05 Milwaukee	3.1	2.9	4.0	5.1	7.0	19	39	58	81	95	46	28	13	10	9
06 St. Louis	35.8	41.0	44.4	85.5	139.8	31	67	150	226	283	580	402	283	197	166
07 Peoria	3.6	4.3	4.8	7.7	11.6	6	15	24	38	53	60	36	24	22	16
08 Chicago	1.9	2.2	2.5	4.0	6.1	3	4	12	18	25	37	21	12	11	9
11 Duluth-Superior	24.6	16.1	41.9	58.2	84.5	168	201	273	390	487	382	248	82	56	51
12 Fargo-Moorhead	3.3	2.2	5.7	7.9	11.2	21	26	34	49	61	58	38	12	9	8
13 Sioux Falls	0.3	0.4	0.7	1.1	1.6	--	1	1	2	3	17	10	6	4	3
Total	123.6	117.1	182.8	283.1	433.3	552	949	1,402	2,068	2,464	2,203	1,423	738	542	470

[a] From "Forest Resource Statistics for the Upper Mississippi River Basin," Table 13, Forest Service, in Part IV, UMRCBS, Appendix P, Draft No. 2.

[b] Minor industrial products include cooperage logs, poles, piling, mine timbers, posts, chemical wood, box bolts, and a miscellaneous assortment of similar items.

Table P-80

Estimated Employment by Economic Subregion in the Upper Mississippi River Basin in Timber-Based Manufacturing Industries – 1952 and 1962, and Projections – 1980, 2000, and 2020 (number of employees)[a]

Economic Subregion	Lumber and Wood Products[b]					Pulp, Paper and Allied Products[c]					Totals				
	1952	1962	1980	2000	2020	1952	1962	1980	2000	2020	1952	1962	1980	2000	2020
01 Minneapolis-St. Paul	4,350	4,600	5,850	7,070	8,570,	6,000	7,150	11,500	15,000	19,300	10,350	11,750	17,350	22,070	27,870
02 Eau Claire	9,550	9,800	12,100	14,530	17,420	6,700	8,000	10,950	13,600	16,500	16,250	17,800	23,050	28,130	33,920
03 Des Moines-Ft. Dodge	1,850	1,850	2,300	3,240	4,420	300	400	600	800	950	2,150	2,250	2,900	4,040	5,370
04 Davenport-Rock Island-Moline	5,300	5,950	6,890	8,890	11,540	1,700	2,050	2,950	3,900	4,700	7,000	8,000	9,840	12,790	16,240
05 Milwaukee	1,350	1,500	1,840	2,190	2,510	4,350	5,100	6,650	8,250	9,800	5,700	6,600	8,490	10,440	12,310
06 St. Louis	14,500	14,950	18,020	24,420	31,970	8,150	9,800	13,050	16,450	19,500	22,650	24,750	31,070	40,870	51,470
07 Peoria	1,600	1,700	1,950	2,430	3,050	3,200	3,850	4,950	6,150	7,300	4,800	5,550	6,900	8,580	10,350
08 Chicago	900	1,000	1,140	1,390	1,710	21,450	25,850	33,350	41,350	48,850	22,350	26,850	34,490	42,740	50,560
11 Duluth-Superior	5,700	4,400	6,900	9,010	12,000	1,500	1,750	2,850	3,700	4,800	7,200	6,150	9,750	12,710	16,800
12 Fargo-Moorhead	750	550	850	1,130	1,570	0	0	0	0	0	750	550	850	1,130	1,570
13 Sioux Falls	100	50	120	140	260	100	100	150	200	250	200	150	270	340	510
Total	45,950	46,350	57,960	74,400	95,020	53,450	64,050	87,000	109,400	131,950	99,400	110,400	144,960	183,840	226,970

[a] Based on a 2,000-hour man-year in 1952 and 1962 and a 1,300-hour man-year starting in 1980.

[b] Includes logging camps engaged in cutting timber and pulpwood, sawmills, veneer mills, shingle mills, cooperage stock mills, planing mills, plywood mills engaged in producing lumber and wood basic materials, and establishments engaged in manufacturing finished articles made entirely or mainly of wood (major group 24 as defined by the Bureau of Census).

[c] Includes establishments manufacturing pulp primarily from wood, from rags and other fibers, converting these pulps into paper or board and the manufacture of paper and paperboard into converted products such as coated paper, paper bags, paper boxes, and envelopes (major group 26 as defined by the Bureau of Census).

Table P-81

Timber Products Output in the Upper Mississippi River Basin by Plan Area — 1952, 1962, and Projections — 1980, 2000, and 2020

Plan Area	*Sawlogs, Veneer Logs and Minor Industrial Products,*[a] *million cubic feet*					*Pulpwood, thousand cords*					*Fuelwood, thousand cords*				
	1952	*1962*	*1980*	*2000*	*2020*	*1952*	*1962*	*1980*	*2000*	*2020*	*1952*	*1962*	*1980*	*2000*	*2020*
1. Mississippi Headwaters	33.0	21.6	55.9	77.6	112.7	225	268	364	520	650	509	331	110	74	67
2. Chippewa and Black	17.7	15.0	24.0	29.9	41.3	124	246	370	510	578	287	199	77	55	49
3 Wisconsin	18.1	16.2	24.8	30.7	41.6	165	325	487	672	764	225	147	58	42	38
4. Rock	3.4	3.5	4.6	6.9	10.8	6	13	22	30	33	73	45	21	16	15
5. Illinois	8.4	9.9	11.2	18.0	27.0	14	35	57	87	122	159	85	54	48	38
6. Kaskaskia	3.6	4.1	4.8	10.0	11.4	8	16	27	42	58	71	34	23	20	17
7. Big Muddy	2.9	3.6	4.1	6.7	9.9	6	15	24	38	51	61	30	20	17	12
8. Meramec	10.1	12.9	20.6	43.3	79.5	1	4	16	26	33	242	193	153	95	85
9. Salt	2.4	3.3	4.5	10.0	18.3	2	2	8	16	19	61	49	39	27	22
10. Fox, Wyaconda, & Fabius	0.9	1.0	1.7	3.3	6.2	–	1	4	8	10	21	16	14	9	8
11. Des Moines	2.8	3.2	5.2	10.7	18.8	1	8	20	27	36	100	54	39	33	29
12. Skunk	0.9	1.0	1.7	3.5	6.1	–	3	5	7	11	32	18	12	10	9
13. Iowa and Cedar	1.5	1.8	3.0	5.6	10.0	–	4	9	13	17	57	33	23	21	18
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	2.3	2.6	4.5	8.6	15.2	–	7	17	24	29	82	47	32	29	25
15. Cannon, Zumbro, & Root	2.2	2.9	4.4	6.2	8.8	–	2	3	4	5	72	45	23	14	12
16. Minnesota	1.9	1.9	3.8	6.3	7.3	–	–	–	–	–	98	65	24	18	15
Total	112.1	104.5	178.8	277.3	424.9	552	949	1,433	2,024	2,416	2,150	1,391	722	528	459

[a] Minor industrial products include cooperage logs, poles, mine timbers, posts, chemical wood, box bolts, and a miscellaneous assortment of similar items.

Table P-82

Estimated Employment by Plan Area in the Upper Mississippi River Basin in Timber-Based Manufacturing Industries — 1952, 1962, and Projections — 1980, 2000, and 2020 (number of employees) [a]

Plan Area	*Lumber and Wood Products*[b]					*Pulp, Paper and Allied Products*[c]					*Totals*				
	1952	*1962*	*1980*	*2000*	*2020*	*1952*	*1962*	*1980*	*2000*	*2020*	*1952*	*1962*	*1980*	*2000*	*2020*
1. Mississippi Headwaters	9,600	8,200	12,180	15,390	19,800	6,800	8,000	13,000	17,000	22,000	16,400	16,200	25,180	32,390	41,800
2. Chippewa & Black	4,600	4,400	5,750	6,700	8,190	2,100	2,500	3,400	4,300	5,100	6,700	6,900	8,970	11,000	13,290
3. Wisconsin	5,570	6,350	8,000	9,770	11,520	6,400	7,600	10,300	12,900	15,600	12,150	13,950	18,300	22,670	27,120
4. Rock	2,050	2,100	2,410	2,970	3,590	800	800	1,050	1,300	1,500	2,850	2,900	3,460	4,270	5,090
5. Illinois	8,800	9,850	11,620	13,800	16,080	24,850	30,000	38,700	48,000	56,700	33,650	39,850	50,320	61,800	72,780
6. Kaskaskia	1,250	1,150	1,400	2,160	2,340	1,500	1,800	2,300	2,900	3,400	2,750	2,950	3,700	5,060	5,740
7. Big Muddy	1,000	1,100	1,300	1,890	2,590	100	100	100	150	200	1,100	1,200	1,400	2,040	2,790
8. Meramec	3,500	3,700	4,540	7,080	10,900	5,700	6,900	10,400	13,800	17,300	9,200	10,600	14,940	20,880	28,200
9. Salt	650	650	790	1,370	2,380	100	100	150	200	250	750	750	940	1,570	2,630
10. Fox, Wyaconda, & Fabius	300	300	360	670	1,070	50	50	50	100	100	350	350	410	770	1,170
11. Des Moines	1,150	1,050	1,370	2,100	2,940	400	500	700	1,000	1,200	1,550	1,550	2,070	3,100	4,140
12. Skunk	250	250	370	630	870	50	50	100	100	100	300	300	470	730	970
13. Iowa-Cedar	1,500	1,600	1,920	2,380	2,990	1,100	1,400	2,100	2,800	3,400	2,600	3,000	4,020	5,180	6,390
14. Turkey, Maquoketa, Wapsipinicon, & Upper Iowa	2,600	2,850	3,240	4,250	5,340	300	400	600	800	1,000	2,900	3,250	3,840	5,050	6,340
15. Cannon, Zumbro, & Root	750	750	900	1,130	1,460	50	50	100	100	150	800	800	1,000	1,230	1,610
16. Minnesota	750	600	700	930	1,130	0	0	0	0	0	750	600	700	930	1,130
Total	44,500	44,900	56,670	73,220	93,190	50,300	60,250	83,050	105,450	128,000	94,800	105,550	139,720	178,670	221,190

[a] Based on a 2,000-hour man-year in 1952 and 1962 and a 1,300-hour man-year starting in 1980.

[b] Includes logging camps engaged in cutting timber and pulpwood, sawmills, veneer mills, shingle mills, cooperage stock mills, planing mills, plywood mills engaged in producing lumber and wood basic materials, and establishments engaged in manufacturing finished articles made entirely or mainly of wood (major group 24 as defined by the Bureau of Census).

[c] Includes establishments manufacturing pulp primarily from wood, from rags and other fibers, converting these pulps into paper or board and the manufacture of paper and paperboard into converted products such as coated paper, paper bags, paper boxes, and envelopes (major group 26 as defined by the Bureau of Census).

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Section 5
MINERAL INDUSTRIES

This section was prepared by the U.S. Bureau of Mines, Twin Cities Office of Mineral Resources, Minneapolis, Minnesota. It deals with the mineral economy of the Upper Mississippi River Basin.

Significant quantities of metallic minerals — iron ore, lead, and zinc; nonmetallic minerals — gypsum, sand and gravel, crushed stone and dimension stone, and mineral fuels — coal, natural gas, peat, and petroleum are found in the 188,200 square miles in the Basin.

In 1964 the Basin supplied about one-tenth of the Nation's bituminous coal; one-seventh of the iron ore; one-eighth of the gypsum, sand and gravel, and stone; two-fifths of the lead; and one-twentieth of the zinc.

5.1 Summary of Selected Mineral Industries, 1950 and 1960

Table P-83 shows mineral production in the Basin for 1950 and 1960. Included in the table are several mineral commodities for which projections of production and employment have not been made. These include cement, clay, and lime for which employment data are shown under manufacturing in Sections 1 and 2 of this appendix. Cobalt, copper, nickel and silver are byproducts of lead mining and the employment is included in the lead mining employment data. Production and/or employment data for abrasive stones, peat, and tripoli are either confidential or not available.

Table P-83
Mineral Production in the Upper Mississippi River Basin — 1950 and 1960

Mineral	1950		1960	
	Quantity	Value	Quantity	Value
Abrasives:				
Grinding pebbles, short tons	530	$ 10,600	W	W
Tube-mill liners, short tons	W	W	W	W
Barite, short tons	209,311	1,890,292	180,702	$ 2,587,820
Cement:				
Masonry, 280-pound barrels	[a]	[a]	1,804,132	5,664,996
Natural, 376-pound barrels	W	W	–	–
Portland, 376-pound barrels	29,958,871	67,330,520	39,640,738	136,562,871
Clays and shale, short tons[b]	3,282,922	4,799,120	4,503,135	12,759,604
Clay produced for use in mfg. cement, short tons	NA	NA	1,181,852	1,164,797
Coal (bituminous), short tons	54,736,582	218,187,673	43,703,487	174,622,865
Cobalt, pounds	–	–	W	W
Copper, short tons	2,982	1,240,512	1,087	697,854
Gypsum, short tons	981,647	2,507,651	1,282,817	5,427,529
Iron ore, long tons[c]	15,940,149	79,230,712	14,597,296	120,147,639
Lead, short tons	135,481	36,579,870	114,358	26,759,772
Lime, short tons	1,308,323	13,117,618	1,846,736	24,609,860
Nickel, pounds	–	–	W	W
Peat, short tons	10,853	98,553	23,829	260,775
Petroleum, thousand 42-gallon barrels	22,862	63,328,767	32,916	97,435,441
Sand and gravel, short tons	47,342,140	37,572,387	92,770,409	88,622,573
Silver, ounces	236,273	213,839	15,594	14,113
Stone (crushed and broken), short tons[d]	33,870,365	45,545,710	73,710,993	100,118,972
Limestone for use in mfg. cement and lime, short tons	NA	NA	11,044,626	10,555,795
Stone (dimension), short tons	145,366	8,108,302	211,493	10,627,672
Zinc, short tons	28,339	8,048,276	41,556	10,721,448
Value of items that cannot be disclosed: Tripoli and values indicated by footnote W	–	666,489	–	1,982,628
Total	–	588,476,891	–	831,345,024

W — Withheld to avoid disclosing individual company confidential data.
NA — Not available.

[a] Masonry cement not considered as "mineral production" in 1950.
[b] Excludes clay produced for use in manufacturing cement.
[c] Includes iron ore containing from 5 to 35 percent manganese, natural, which is ordinarily classified by the Bureau of Mines as manganiferous ore.
[d] Excludes limestone produced for use in manufacturing cement and lime.

Mineral production is defined as production measured by mine shipments, sales, or marketable production (including consumption by producers).

Employment is based primarily on man-hours logged by production workers. Number of employees is calculated by specific mineral commodity industry by an equivalent man-year determined for that industry. For example, in the iron ore industry a man-year is equated to 2,000 man-hours. For the sand and gravel industry a man-year is equivalent to 1,800 man-hours, reflecting the seasonal aspects of the industry. An exception is the coal industry where number of employees is determined by the average number of men working on active mine days.

5.2 Existing and Projected Mineral Reserves in the Basin

Detailed information on mineral reserves, by mineral commodity, is presented in Appendix F, Mineral Resources. With a few exceptions mineral reserves in the Basin are adequate to meet projected demands through 2020.

For several years petroleum production in the Basin has exceeded new discoveries, and reserves have steadily depleted. If the present decline in reserves continues, it is estimated that by 1980 production in the Basin will be on a "stripper" basis and a fraction of current output.

Reserves of barite in Missouri are estimated to be adequate to 1980. If new methods of recovering barite from tailing dumps can be developed, production could be prolonged.

Reserves of iron ore in Fillmore County in southern Minnesota are limited. Mining at the current rate would substantially deplete reported reserves by 1980.

5.3 Projections of Selected Mineral Commodities by Plan Areas, 1970–2020

Tables P-84 and *P-85* detail mineral employment for selected commodities by plan areas for 1960 and projected 1970, 1980, 2000, and 2020. *Table P-86* shows projected minerals production in the Basin for 1970, 1980, 2000, and 2020. Additional data and projections of minerals employment and production by plan areas is contained in Part V, Draft No. 2 of Appendix P dated June, 1968.

Projections of mineral production and employment for selected mineral commodities were based on data compiled by the Bureau of Mines canvasses of the mineral industry. An exception is petroleum data which were compiled by the oil-producing states and furnished to the Bureau of Mines.

Regression analysis was employed to develop an equation which was used in computing base year (1960) production. A 14-year time series (1950-1963) was used for projecting individual mineral commodities. In some instances, minerals were not produced in every year of the time series, or data were not available. In these cases a shorter time series was used. This calculated figure for 1960, in place of an actual production figure, was used for the base year as the starting point for making projections because it was believed to be more representative of the production trend.

Table P-84

Mining Employment in UMRB Plan Areas by Selected Commodities – 1960, and Projected – 1970, 1980, 2000, and 2020 (number of employees)

Commodities	*1960*	*1970*	*1980*	*2000*	*2020*
Coal	9,300	9,800	9,800	9,000	7,300
Iron ore	3,435	5,550	7,800	9,900	11,900
Lead and zinc	2,370	4,110	4,250	5,165	6,280
Sand and gravel	5,343	6,504	7,682	10,530	13,138
Crushed stone[a]	5,567	8,204	9,956	13,003	14,623
Dimension stone	1,470	1,659	1,822	2,475	2,883
Gypsum	481	372	387	528	664
Barite	356	600	600	–	–
Petroleum	2,550	1,425	450	225	225
Total	30,872	38,224	42,474	50,826	57,013

[a] Excludes data for captive quarries at cement and lime operation.

Table P-85

Total Mining Employment in the UMRB for Selected Mineral Commodities[a] by Plan Areas – 1960, and Projected – 1970, 1980, 2000, and 2020 (number of employees)

Plan Area	*1960*	*1970*	*1980*	*2000*	*2020*
1	4,471	5,009	5,682	7,576	9,324
2	181	417	455	515	354
3	532	656	792	1,040	1,197
4	1,368	1,621	1,863	2,300	2,585
5A	2,850	3,551	4,251	5,795	6,760
5B	4,184	4,693	5,155	6,206	7,020
6	4,216	3,823	3,220	2,994	2,680
7	4,900	4,559	4,336	3,859	3,395
8	3,546	7,965	10,402	12,332	14,776
9	223	406	447	522	351
10	95	127	150	195	218
11	912	1,330	1,441	1,658	1,509
12	293	322	350	397	326
13	904	1,186	1,349	1,635	1,812
14	271	418	481	580	632
15	492	599	659	902	1,121
16	953	1,170	1,327	1,792	2,089
Total[b]	30,872	38,224	42,747	50,826	57,013

[a] Includes coal, petroleum, iron ore, lead, zinc, sand and gravel, crushed stone, dimension stone, gypsum, and barite.

[b] Totals do not add because coal employment of less than 100 is not included in plan area totals but are in grand total. Employment in gypsum mining included in grand total but not in plan area totals to avoid disclosing confidential data.

Table P-86

Mineral Production by Selected Commodities, Projected for UMRB Plan Areas – 1970, 1980, 2000, and 2020

Commodity	*1970*	*1980*	*2000*	*2020*
Barite, thousand short tons	300	300	[a]	–
Coal, thousand short tons	56,500	74,300	87,100	77,500
Gypsum, thousand short tons	2,230	2,860	5,600	9,700
Iron ore (usable), thousand long tons	21,150	26,750	34,750	42,000
Lead (recoverable content of ores), thousand short tons	403	478	653	903
Petroleum, thousand barrels	18,500	5,000	2,500	2,500
Sand and gravel, thousand short tons	141,812	205,534	387,764	613,529
Stone:				
Crushed, thousand short tons[b]	127,632	188,403	351,588	540,682
Dimension, short tons	247,852	334,599	641,314	1,044,070
Zinc (recoverable content of ores), thousand short tons	47	49	53	58

[a] Mining at the indicated rate would substantially deplete estimated reserves. Development of new methods for recovering barite from tailings dumps could prolong production.

[b] Excludes limestone produced for use in manufacturing cement and lime.

Projections for minerals used in construction (sand and gravel, crushed stone, dimension stone, and gypsum) were based on projections developed by the Corps of Engineers of the value of construction (in 1960 dollars) in the Basin. The Corps of Engineers construction projections (1970 2020) were made for the 11 economic subregions in the Basin, broken down by selected activities, e.g., new construction, public, private, residential, nonresidential, highways, maintenance, and repair, etc. The Bureau of Mines determined from an analysis of its sand and gravel canvass the proportion of production used for highway construction, maintenance, and for building purposes. Rates of change based on Corps of Engineers projections for each subregion for appropriate construction activities were applied to these data, and projected sand and gravel output derived. A similar procedure was used in projecting other residentiary minerals used in construction.

To arrive at Basin plan area projections for sand and gravel and crushed stone, certain calculations were made. Actual production data for 1960 in the economic subregion was used to obtain a percentage of the total subregion production for each county. These percentages were applied to the economic subregion projections to obtain projected production for each county. The appropriate county figures were totaled to arrive at Basin plan area projection totals.

For construction materials considered to be export commodities (dimension stone and gypsum), the rate of change in construction expenditures for the entire Basin was used. It was assumed that change would be determined by regional or even national demands for construction materials rather than by local ones.

Projections of coal production in the Basin were based on energy growth data supplied by the Federal Power Commission for coal consumed by the electric utility industry, and on data developed by the Division of Economic Analysis, Bureau of Mines for nonutility consumption. Although energy demand was projected to increase at a substantial annual growth rate, the proportion of energy to be supplied by coal will decline as nuclear energy increases. Projections of the amount of nuclear energy capacity used for electric power generation, developed by the Federal Power Commission, were taken into consideration in projecting coal output. It should be noted that because of the rapid acceleration of the growth of planned nuclear capacity for electric power generation, the coal projections are subject to revision.

Iron ore projections in Minnesota were based on data developed by the Bureau of Mines and the University of Minnesota. It is assumed that the future production in the Basin will continue as 20 percent of the Minnesota total. The development of the taconite industry had a major influence on projections of future iron ore production. The downward trend of iron ore production in recent years has been reversed. Projections indicate that iron ore output may equal or exceed the high production level of postwar years.

Projections for the iron ore industry in Missouri reflect the announced planned output of the new operations.

Projections of lead and zinc production in Missouri are based on parameters reflecting national demand for these commodities. They were derived from rates of change in demand for varying future periods developed by several agencies including the Division of Economic Analysis, Bureau of Mines, National Planning Association, Predicasts, Resources of the Future, Inc., and the U.S. Department of Commerce.

In the Illinois-Wisconsin lead-zinc district, projections of future production were maintained near the current level of output. It is the practice of operating companies in the district to maintain 10- to 15-year ore reserves. Since the peripheral limits of the district have not been firmly established and there are areas having favorable characteristics for finding ore, it was assumed that production at the indicated rate will be maintained through the projecting period.

Petroleum projections considered the declining oil production in recent years, diminishing reserves, and the effects of secondary production by waterflooding. Published reserves have been declining at the rate of 6.4 percent per year since 1960, and about two-thirds of the output is from secondary production. It is assumed that from 1980 to the end of the projection period, petroleum production will be minimal, as the oil fields become exhausted.

Projections of employment in the mineral industry were based on productivity in the base year adjusted for changes in productivity over the projection period. Changes in productivity for each mineral commodity, e.g., coal, iron ore, construction minerals, base metals etc., were developed from material compiled by the Bureau of Mines, and other Federal and State agencies.

Employment in the petroleum industry was based on data developed by the National Planning Asssociation from 1960 employment figures for Standard Industrial Classification 131 (crude petroleum and natural gas).

Basin plan area and economic subregion totals differ because 19 peripheral counties in the economic subregions were excluded from the Basin plan areas.

5.4 Productivity

Productivity is a measure of output per worker, generally computed by dividing production by number of production workers, to arrive at an hourly, daily, or annual productivity rate. Changes in productivity generally

indicate either an increase or decrease in the efficiency of an operation. Productivity can be useful in comparing mining operations with similar characteristics, but other comparisons would not be meaningful.

In mining operations several factors not implicit in such data have an effect on productivity. Type of mining (underground or surface), depth of deposit, size of equipment used, size of operation, and metal content of ores shipped each affect output per worker to some degree. Productivity rates vary from mine to mine, and from one area to another, due to the variables cited above.

Basinwide, productivity in nonmetallic mining operations, notably sand and gravel and crushed stone, is expected to increase substantially over the projection period, as more efficient and larger equipment is employed.

In coal mining, productivity is expected to approach the optimum during the projection period, based on present estimates of future technological change, in both underground and surface mines. Output per worker will be larger in surface (strip) mining, as it is now, because of the nature of the operation. As coal reserves amenable to strip mining are exhausted and a larger proportion of coal is mined underground, the overall productivity of coal mining in the Basin will be relatively lower.

In iron ore mining, where type of material produced has been changing and will continue to change over the projection period, the metal content has been increasing as lesser quantities of natural iron ores and larger amounts of pellets are being produced. Although productivity rates show little change over the period when based on gross weight, significant increases would be evident, if iron content were the criterion used.

5.5 Data and Projections of Selected Mineral Commodities by Economic Subregions, 1950 and 1960 Actual, and 1970–2020 Projected

The following *Tables P-87* through *P-94* contain employment and production data and projections for UMRB economic subregions. *Tables P-87* and *P-88* list data and projections on employment by selected commodity and total employment for selected mining activities, respectively. *Table P-89* shows total mineral production by selected commodities. *Tables P-90* through *P-94* show production and employment for five major mineral commodities—coal, iron ore, lead and zinc, sand and gravel, and crushed stone for 1950 and 1960 and projected 1970, 1980, 2000, and 2020. The data were collected, compiled and published by the Bureau of Mines, U.S. Department of the Interior.

Table P-87
Mining Employment in UMRB Economic Subregions by Selected Commodities — 1950, 1960, and Projected — 1970, 1980, 2000, and 2020
(number of employees)

Commodity	*1950*	*1960*	*1970*	*1980*	*2000*	*2020*
Coal	30,279	9,571	9,800	9,800	9,000	7,300
Iron ore	4,429	3,435	5,550	7,800	9,900	11,900
Lead and zinc	2,954	2,370	4,110	4,250	5,165	6,280
Sand and gravel	3,946	5,471	6,639	7,241	10,768	13,464
Crushed stone[a]	3,428	5,850	8,555	10,364	13,546	15,162
Dimension stone	1,862	1,742	1,759	1,933	2,629	3,059
Gypsum	501	481	372	387	528	664
Barite	422	356	600	600	–	–
Petroleum	NA	NA	1,425	450	225	225
Total	47,821	29,276	38,810	43,425	51,761	58,054

NA–Not available

[a] Excludes data for captive quarries at cement and lime operations.

Table P-88

Mining Employment in the UMRB for Selected Mineral Commodities[a] by Economic Subregions – 1950, 1960, and Projected – 1970, 1980, 2000, and 2020 (number of employees)

Economic Subregion	*1950*	*1960*	*1970*	*1980*	*2000*	*2020*
I	1,670	2,438	2,870	3,500	4,306	5,820
II	706	708	1,056	1,137	1,368	1,303
III[b]	2,494	1,998	2,336	2,549	2,950	3,114
IV[b]	1,290	1,584	1,892	2,106	2,423	2,578
V	1,056	1,427	1,689	2,140	3,031	3,799
VI	24,854	10,940	15,876	18,570	20,070	21,622
VII	8,547	3,369	3,919	4,172	5,204	5,960
VIII	2,000	2,756[b]	3,533	4,252	5,638	6,302
A	4,372[b]	3,168[b]	3,394	3,651	4,791	6,005
B	52	83	92	84	80	79
C	267[b]	283[b]	356	387	497	583
Total[c]	47,821	29,276	38,810	43,425	51,761	58,054

[a] Includes coal, petroleum, iron ore, lead, zinc, sand and gravel, crushed stone, dimension stone, gypsum, and barite.

[b] Incomplete total. Excludes certain data which must be withheld to avoid disclosing individual company confidential data; however, these data are included in total.

[c] Includes employment for the petroleum industry which cannot be assigned to specific Economic Subregions, except for 1950 and 1960, for which no petroleum employment data are available.

Table P-89

Mineral Production by Selected Commodities, Total for UMRB Economic Subregions – 1950, 1960, and Projected – 1970, 1980, 2000, and 2020 (thousand short tons unless otherwise noted)

Commodity	*1950*	*1960*	*1970*	*1980*	*2000*	*2020*
Coal	54,737	43,703	56,500	74,300	87,100	77,500
Iron ore[a]	15,940	14,597	21,150	26,750	34,750	42,000
Lead	135	114	403	478	653	903
Zinc	23	42	47	49	53	58
Sand and gravel	47,342	92,770	145,165	210,252	397,180	629,266
Crushed stone[b]	33,870	73,711	133,006	196,294	366,433	563,735
Dimension stone	145	211	288	389	745	1,213
Gypsum	982	1,283	2,230	2,860	5,600	9,700
Barite	209	181	300	300	[c]	–
Petroleum[d]	22,862	32,916	18,500	5,000	2,500	2,500

[a] Thousand long tons.

[b] Excludes limestone produced for use in manufacturing cement and lime.

[c] Mining at the indicated rate would substantially deplete estimated reserves. Development of new methods for recovering barite from tailings dumps could prolong production.

[d] Thousand barrels.

Table P-90

Production and Employment for Coal in the UMRB for Economic Subregions – 1950, 1960, and Projected – 1970, 1980, 2000, and 2020

Economic Subregion	*1950*	*1960*	*1970*	*1980*	*2000*	*2020*
Production (thousand short tons):						
III	1,882	1,068	1,500	1,900	2,100	1,900
IV	180	101	100	200	300	200
VI	32,765	27,923	35,800	47,100	55,200	49,200
VII	18,588	13,923	18,100	23,900	28,000	24,900
VIII	1,321	689	1,000	1,200	1,500	1,300
Total[a]	54,737	43,703	56,500	74,300	87,100	77,500
Employment (number of employees):						
III	1,605	470	400	400	400	300
IV	116	49	(b)	(b)	(b)	(b)
VI	20,513	6,441	6,600	6,600	5,700	4,600
VII	7,572	2,452	2,600	2,600	2,700	2,300
VIII	473	159	200	200	200	100
Total	30,279	9,571	9,800	9,800	9,000	7,300

[a] Data may not add to totals shown because of independent rounding.
[b] Less than 100 employed.

Table P-91

Production and Employment for Iron Ore in the UMRB Economic Subregions – 1950, 1960, and Projected – 1970, 1980, 2000 and 2020

Economic Subregion	*1950*	*1960*	*1970*	*1980*	*2000*	*2020*
Production (thousand long tons):						
A	15,424	12,901	15,000	16,000	22,000	28,000
II	322	462	1,150	750	750	–
VI	194	235	5,000	10,000	12,000	14,000
Total[a]	15,940	14,597	21,150	26,750	34,750	42,000
Employment (number of employees):						
A	4,353	3,099	3,300	3,600	4,700	5,900
II	12	53	250	200	200	–
VI	64	283	2,000	4,000	5,000	6,000
Total	4,429	3,435	5,550	7,800	9,900	11,900

[a] Data may not add to total shown because of independent rounding.

Table P-92

Production and Employment for Lead and Zinc in the UMRB for Economic Subregions – 1950, 1960, and Projected – 1970, 1980, 2000, and 2020

Economic Subregion	*1950*	*1960*	*1970*	*1980*	*2000*	*2020*
Production (thousand short tons):						
Lead:						
IV	2	2	3	3	3	3
VI	134	112	400	475	650	900
Total Lead	136	114	403	478	653	903
Zinc:						
IV	27	39	39	40	40	40
VI	2	3	8	9	13	18
Total Zinc	29	42	47	49	53	58
Employment (number of employees):						
Lead:						
IV	[a]	[a]	[a]	[a]	[a]	[a]
VI	2,600	1,990	3,750	3,900	4,850	6,000
Zinc:						
IV	346	380	360	350	315	280
VI	[b]	[b]	[b]	[b]	[b]	[b]

[a] Included in Economic Subregion VI.
[b] Included in Economic Subregion IV.

Table P-93

Production and Employment for Sand and Gravel in the UMRB for Economic Subregions – 1950, 1960, and Projected – 1970, 1980, 2000, and 2020

Economic Subregion	*1950*	*1960*	*1970*	*1980*	*2000*	*2020*
Production (thousand short tons):						
I	5,915	17,766	30,981	48,549	94,817	147,585
II	2,976	4,586	7,012	9,990	17,036	24,567
III	5,870	9,429	13,133	17,655	29,273	42,511
IV	2,654	3,966	5,723	7,637	12,823	18,804
V	7,125	14,503	22,974	35,439	71,043	114,833
VI	4,935	8,732	12,469	16,801	30,454	45,610
VII	8,411	10,051	16,707	23,909	51,414	100,984
VIII	8,153	19,423	30,344	43,558	81,275	123,087
A	282	1,167	2,018	2,398	3,256	4,765
B	330	1,540	1,770	1,869	2,200	2,543
C	692	1,556	2,034	2,447	3,589	3,976
Total	47,342	92,770	145,165	210,252	397,180	629,266
Employment (number of employees):						
I	389	986	1,344	1,727	2,471	3,045
II	208	236	282	330	412	470
III	556	792	861	950	1,153	1,326
IV	236	278	313	343	422	490
V	514	722	894	1,131	1,669	2,125
VI	486	583	647	716	950	1,127
VII	750	556	722	847	1,334	2,076
VIII	722	1,083	1,322	1,557	2,129	2,553
A	19	69	94	91	91	105
B	22	83	75	65	56	51
C	44	83	85	84	90	96
Total	3,946	5,471	6,639	7,841	10,768	13,464

Table P-94

Production and Employment for Crushed Stone in the UMRB for Economic Subregions – 1950, 1960, and Projected – 1970, 1980, 2000, and 2020

Economic Subregion	*1950*	*1960*	*1970*	*1980*	*2000*	*2020*
Production (thousand short tons):						
I	1,172	2,461	4,328	6,886	13,581	21,256
II	2,147	3,221	4,841	6,929	11,884	17,253
III	2,951	8,926	16,062	21,833	36,356	53,188
IV	5,564	10,887	18,514	26,150	44,433	65,260
V	2,332	5,595	8,563	13,776	28,017	45,377
VI	7,193	15,826	35,315	52,445	96,642	114,223
VII	2,860	5,055	10,303	15,235	35,154	65,375
VIII	9,428	21,328	34,706	52,630	99,731	151,027
A	1	3	–	–	--	–
B	--	11	11	11	14	17
C	222	398	63	408	621	759
Total	33,870	73,711	133,066	196,294	366,433	563,735
Employment (number of employees):						
I	236	389	555	725	1,000	1,135
II	306	396	373	437	526	556
III	333	736	1,075	1,199	1,397	1,488
IV	583	861	1,190	1,380	1,641	1,755
V	347	472	587	775	1,104	1,301
VI	611	1,194	2,166	2,629	3,405	3,700
VII	222	361	597	725	1,170	1,584
VIII	778	1,514	2,000	2,482	3,292	3,629
A	–	–	–	–	–	–
B	NA	NA	2	2	1	1
C	NA	NA	10	10	9	9
Total	3,428	5,850	8,555	10,364	13,546	15,162

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Section 6
ELECTRICAL POWER INDUSTRY*

6.1 Organization of the Power Industry

For purposes of delineating and describing the power industry in the Upper Mississippi River Basin area, the Power Region boundary has been established as shown in *Figure P-57*, with plan area designations corresponding to FPC Power Supply Areas to coincide with the manner in which the utilities report to the FPC. Unless stated otherwise, information given by PSA includes only that portion of the PSA within the Power Region. This region includes parts of PSAs 12, 13, 15, 16, 17, 26, 40 and the whole of 14. The portion of PSA 26 included is so minor that it cannot be considered typical of the PSA. The section of PSA 12 included is also small, but is a very highly industrialized area with steel mills, chemical plants and oil refineries which at the present time are experiencing a very high rate of expansion. PSA 15 includes the city of St. Louis with St. Louis and Jefferson counties but not St. Charles and Franklin counties. The city of Milwaukee is outside of the boundary, but its proximity will be felt within the region.

The UMRB Power Region, as of 1960, had 538 electric utility systems of which 56 were investor-owned, 323 were municipal, and 159 were cooperative. The generating capacity and loads of the investor-owned utilities comprise by far the largest segment, approximating 90 percent of the total. The remaining 10 percent is about evenly divided between the municipal systems and the cooperatives. About one-half of the municipal systems, which for the most part are quite small, have generating equipment often supplemented by external purchases. The cooperative group is comprised of a few generating and transmission systems and numerous distribution cooperatives varying considerably in size.

The composition of the industry as to type and size varies widely within the region. PSAs 16 and 17, predominantly rural, contain a large number of small systems while PSA 14, with a high population density, is served by few systems.

Considering that future estimates place population growth in the suburban areas at approximately four times the nonmetropolitan areas, it would be expected that the present pattern may become more predominant. In 1960 the UMRB included an area of 178,000 square miles with a population of 18,805,477, accounting for 5.0 percent of the area of the Nation and 10.5 percent of the population as shown in *Table P-95*. The average population density of 106 per square mile is slightly more than double the national average and varies considerably within the Basin. PSAs 13, 16, 17, and 40 have densities below 80 while PSA 14, where Chicago is situated, averages 435.

In perspective, the electric power requirements of the UMRB Power Region in 1960 were approximately 8.7 percent of the national total, or 73.9 billion kwh supplied by both utilities and self-generation. The total generating capacity was 17,100 megawatts representing 9.2 percent of the national total.

6.2 Components of Electric Power Supply

Steam plants using coal and gas as fuels generate the major portion of electrical energy in the UMRB Power Region. There are numerous small diesel plants, but these account for a negligible portion of the total supply. The gas turbine is becoming popular as a source of peaking and emergency power, but in this application it is only a small part of the total.

Table P-96 shows the fuel-electric and hydroelectric generation for 1960 by PSAs while *Table P-97* shows the transfers of electric power for each PSA in that year. The UMRB Power Region used a net import of 3,672 million kwh and 564 mw of capacity generated outside of the area.

The trend toward ever larger plants to realize higher efficiencies and economies of scale follows the national pattern, becoming even more pronounced with the advent of nuclear power. The huge financing costs are often beyond the capability of a single utility, and this factor together with the requirements for larger loads to match the increasing sizes of plants will promote a tendency toward joint efforts of several utilities in a single project.

Hydroelectric plants in the UMRB accounted for only 5 percent of the 1960 generating capacity compared to a 19-percent average for the Nation. Within the Basin, the hydroelectric capacity varies considerably, with PSAs 13, 15, and 16 accounting for 90 percent of the total. The Taum Sauk pumped storage project of the Union Electric Co., having a capacity of 350 mw and now in its fourth year of commercial operation, has drawn world-wide interest.

*Based on more detailed information contained in Appendix M, Power.

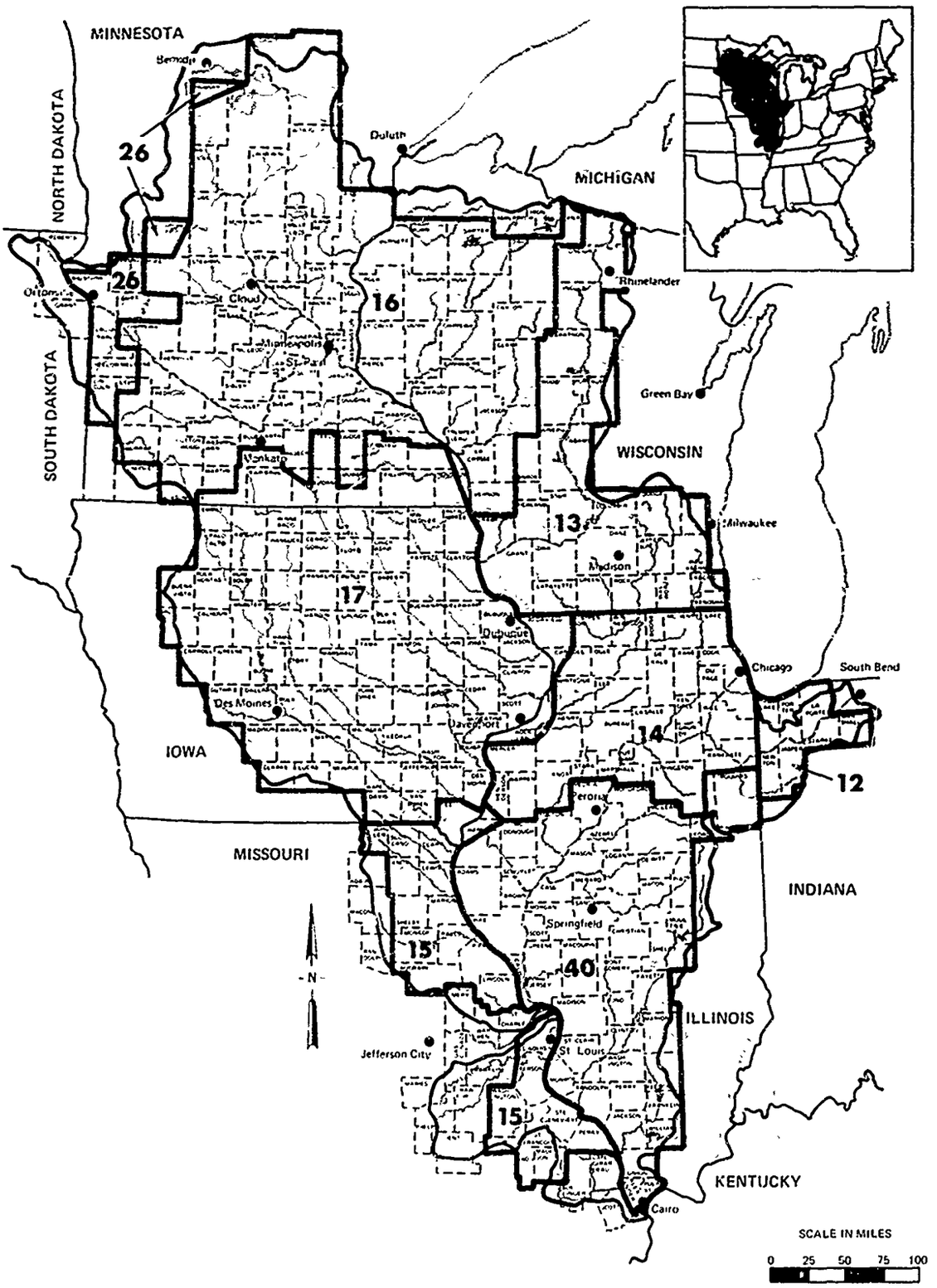

Figure P-57. Upper Mississippi River Basin power region boundary and area boundaries.

Table P-95

Population Density – UMRB Power Region by Power Supply Areas – 1960

PSA	Area, sq. miles	Population	Density, pop./sq. mile
12	3,274	749,357	229
13	19,609	1,456,462	74
14	16,540	7,200,958	435
15	11,354	1,811,891	160
16	51,268	2,923,698	57
17	44,680	2,462,214	55
26	4,088	85,553	21
40	27,181	2,115,344	78
Total UMRB	177,994	18,805,477	106
Total U.S.	3,548,974	179,323,175	51
UMRB % of U.S.	5.0	10.5	

Table P-96

Electric Power Supply in the UMRB Power Region – 1960

FPC Power Supply Area	Fuel Electric Generation			Hydroelectric Generation			Total Generation		
	Capacity, 1000 kw	Annual Production, million kwh	Capacity Factor, %	Capacity, 1000 kw	Annual Production, million kwh	Capacity Factor, %	Capacity, 1000 kw	Annual Production, million kwh	Capacity Factor, %
12	634.3	3,194	57.3	–	–	–	634.3	3,194	57.3
13	691.6	2,462	40.5	128.8	868	76.7	820.4	3,330	46.2
14	5,922.7	24,131	46.4	30.2	108	40.7	5,952.8	24,239	46.4
15	1,603.7	7,322	52.0	121.6	847	79.3	1,725.3	8,169	53.9
16	2,072.6	8,134	44.7	253.3	1,208	54.3	2,325.9	9,342	45.7
17	1,835.5	6,661	41.3	20.3	65	36.5	1,855.8	6,726	41.2
26	27.3	55	22.9	–	–	–	27.3	55	22.9
40	2,057.7	7,435	41 1	2.5	19	86.5	2,060.2	7,454	41.2
Total Region	14,845.4	59,394	45.5	556.7	3,115	63.7	15,402.0	62,509	46.2

Table P-97

Transfers of Electric Power Across the UMRB Power Region Boundary – 1960

FPC Power Supply Area	Import		Export		Net Transfer			
					Import		Export	
	Energy, 1000 kwh	Capacity, kw	Energy, 1000 kwh	Capacity, kw	Energy, 1000 kwh	Capacity, kw	Energy, 1000 kwh	Capacity, kw
12	881,529	200,000	518,568	70,000	362,961	130,000		
13	1,670,200	380,000	502,000	101,000	1,168,200	279,000		
14	980,213	126,000	258,766	120,000	721,447	6,000		
15	102,000	139,000	183,000	249,000			81,000	110,000
16	245,845	35,000	326,823	47,000			80,978	12,000
17	631,254	108,000	93,713	9,000	537,541	99,000		
26	90,300	23,000	–	–	90,300	23,000		
40	1,373,689	229,000	420,141	80,500	953,548	148,500		
Total Region	6,001,030	1,240,000	2,303,011	676,500	3,672,019	563,500		

The technological development of higher transmission voltages has made the moving of larger blocks of electric power over longer distances practical. It has encouraged a trend toward integration of utilities into larger operating systems providing lower capital and operating costs.

6.3 The Industry's Prospects for Growth, 1970, 1980, 2000, 2020

Increased growth can naturally be expected to accompany population growth and economic expansion, but the electrical industry has historically exceeded these growth rates. Progressively higher standards of living will also expand the future market, but the greatest incentive will come from the reduction in costs for electric energy relative to other elements in the cost of living. Many avenues of approach are apparent today for this realization. Among these are:

(1) Technological developments such as nuclear power, EHV, pumped storage, and possible other developments in generation, transmission, and distribution which are still in the research stage.

(2) Lower fuel costs through lower mining and transportation costs and pricing pressures from competing fuels.

(3) Coordination of the industry to take advantage of load diversity, sharing of reserves, installations of larger units, and economy exchanges.

The most promising growth markets today appear to be home heating and air conditioning with potentials also existing in increased lighting and transportation (both rail and automobile). These markets will not go without a challenge from other sources of energy. The railroads are testing jet-powered trains. The gas industry is engaged in very intensive research programs that well may lead to aggressive competition in the air conditioning market and counter the electric utility bid for the home heating market. Battery propelled electric autos may be in competition with autos powered by fuel cells. The gas industry is also vigorously pursuing the total energy concept for onsite generation with a potential for competing with up to 8 percent of the electrical energy market by 1975. Such installations have increased in number from 100 in 1964 to over 650 in 1968.

The electric power industry must intensify its efforts aimed at acceptance of its facilities. This involves environmental considerations such as air and water pollution, overcoming public concern about nuclear plants in congested areas and aesthetic features that may require underground distribution and even possible underground transmission. Further, the industry is faced with increasing costs for right-of-ways and plant sites in fast growing urban areas. Larger capital costs can be expected for the provision of cooling towers where an adequate water supply is not available. It is apparent, then, that while the potential for a continued rapid rate of growth in electrical energy use is indeed bright, it is not necessarily assured--especially at present levels--beyond 1980.

The projected requirements within the Basin by classified use to 1980 are given in *Table P-98* while growth rates for each category are given in *Table P-99*. The projections indicate an 8 percent average annual increase for residential use. Projection for individual PSAs by classified use to 1980 are given in *Table P-100*. Total energy requirements to the year 2020 for the region and each PSA are given in *Table P-101* while *Figure P-58* shows the estimated annual peak demand. The projections of future power requirements to 1990 are based on estimates by the West Central Regional Advisory Committee in cooperation with the FPC, developed for updating the National Power Survey Report of 1964.

6.4 Conclusions Regarding Future Electric Energy Needs and Supply

The projections for this study extend beyond four decades into the future. As an interesting observation it might be noted that had a similar forecast been made just a little more than two decades ago, there would have been no provision for an entirely new source of energy, nuclear, in the generation of electricity. The utilization of new methods for converting the energy in fossil fuels and nuclear energy into electrical energy within the next four or five decades would appear to be quite probable since some of these innovations are already in the laboratory stage or beyond. These approaches include the development of magnetohydrodynamics (MHD), electrogas dynamics (EGD), thermonuclear fusion reactors, thermoelectric generation, thermionic generation and fuel cells. Some methods could be highly efficient and fairly simple through a direct conversion of a nonelectrical energy source into electrical energy. Although much confidence may exist that some of these developments will materialize, they cannot be precisely accounted for in a projection, but should be given due recognition.

The type of power generating equipment to be installed in the UMRB can have a profound effect on the economics of the Basin, not only from the standpoint of the huge investments involved but also from the standpoint of the fuel source. In view of the recent rapid advances in the amount of nuclear fueled capacity on order, it is necessary to carefully consider this as a major component of future generating capacity.

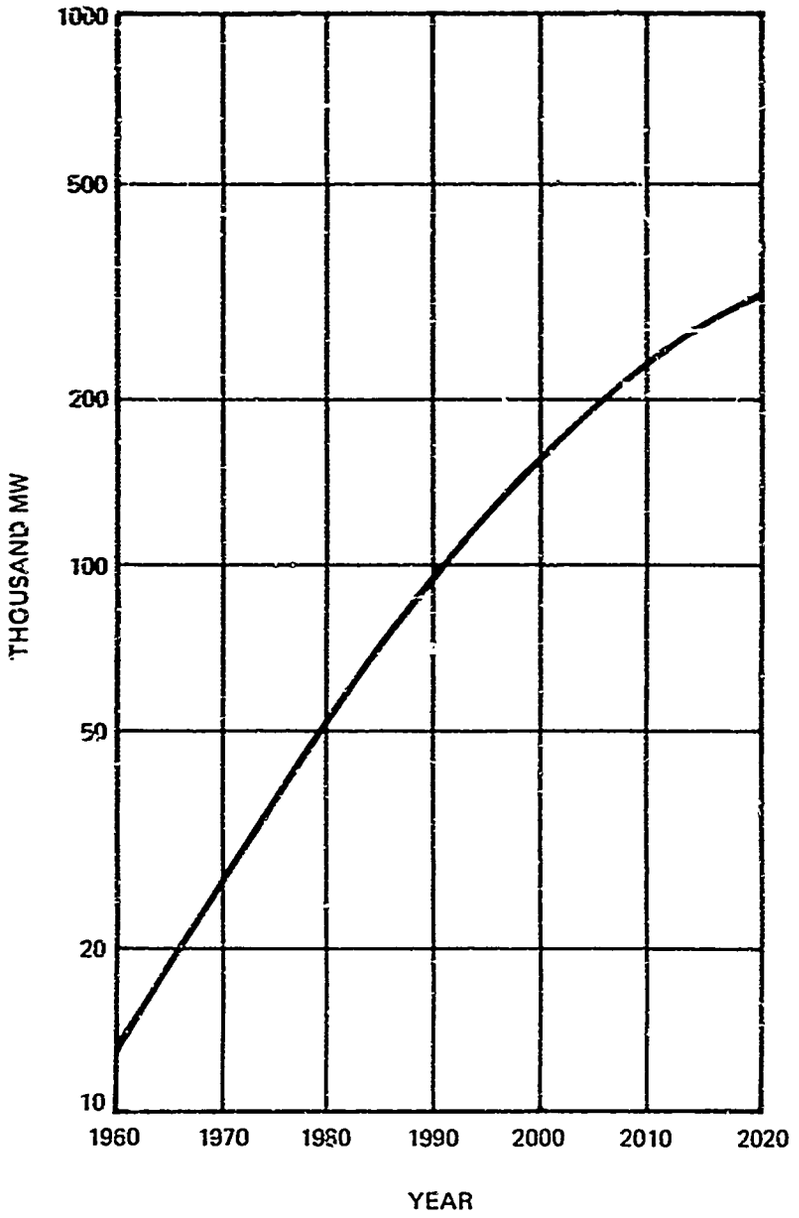

Figure P-58. Upper Mississippi River Basin power region annual peak load.

Table P-98

UMRB Power Region Annual Electric Power Requirements by Categories of Use — 1960–1980

Category of Use	1960 Actual		1965 Actual		1976 Projected		1980 Projected	
	million kwh	% of total	million kwh	% of total	million kwh	% of total	million kwh	% of total
Electric Utilities:								
Farm	4,196	6.3	5,090	5.5	7,900	5.8	15,370	5.5
Residential	16,012	24.2	22,688	24.5	35,120	25.6	74,020	26.6
Commercial	11,421	17.3	16,531	17.8	24,510	17.9	50,480	18.2
Industrial	24,879	37.6	35,953	38.8	51,800	37.8	104,550	37.6
Street lighting	792	1.2	1,068	1.2	1,530	1.1	2,890	1.0
Other	2,502	3.8	3,458	3.7	4,890	3.6	9,950	3.6
Losses	6,379	9.6	7,878	8.5	11,300	8.2	20,830	7.5
Total Requirements	66,181	100.0	92,663	100.0	137,050	100.0	278,090	100.0
Industrial In-plant Generation	7,679	—	8,721	—	9,420	—	11,400	—
Total	73,860	—	101,384	—	146,470	—	289,490	—

Table P-99

UMRB Power Region Projected Rate of Increase of Electric Requirements by Categories of Use — 1960–1980

Category of Use	Increase in Power Requirements 1960 to 1980		Average Annual Increase, percent	Number of Years to Double Consumption
	million kwh	percent		
Electric Utilities:				
Farm	11,174	266	6.7	11
Residential	58,008	362	8.0	9
Commercial	39,059	342	7.7	9
Industrial	79,671	320	7.4	10
Street lighting	2,098	265	6.7	11
Other	7,448	298	7.2	10
Losses & unaccounted for	14,451	226	6.1	12
Total Utility	211,909	320	7.4	10
Industrial Establishments:				
In-plant generation	3,721	48	2.0	35
Total	215,630	292	—	—

The prediction of nuclear capacity, especially much beyond the immediate future, must be made on very little historical data such as exists for the estimate of total supply requirements. In the latter case, a long-term trend can be extrapolated with modifications to correspond with anticipated changes. Nuclear generation, however, must be projected from a point. In this case every attempt must be made to assess all available indications such as the opinions of manufacturers and utilities especially as they are translated into dollar commitments, the opinions of the Atomic Energy Commission, the comments of competing fuel industries, and the findings of various independent studies.

Many factors that will influence future decisions are yet to be resolved, and a more accurate quantitative analysis will be possible only after several years of experience with the nuclear plants now under construction or on order due for startup in the near future. The public acceptance of nuclear plants in populous areas, the degree of public concern over air pollution with coal-fired plants, and the extent to which the coal industry will challenge nuclear power (bearing in mind that considerable research is in progress concerned with the development of new markets for coal) are yet to be determined. The possible developments in coal transportation and electrical energy transportation through EHV transmission will be factors. Nuclear generation with its lower thermal efficiency requires more water

Table P-100
Classification of Energy Use in UMRB Power Region
(million kwh)

	PSA 12	PSA 13	PSA 14	PSA 15	PSA 16	PSA 17	PSA 26	PSA 40	Total
1960									
Farm	139	540	383	128	1,010	1,252	59	685	4,196
Residential	695	1,570	5,543	2,049	2,541	1,873	35	1,705	16,012
Commercial	301	933	5,520	1,074	1,288	1,276	29	1,000	11,421
Industrial	2,215	1,091	9,423	4,443	2,733	2,125	4	2,845	24,879
Street Lighting	44	65	335	70	124	99	2	53	792
Other	135	111	1,602	135	241	166	6	106	2,502
Total	3,529	4,310	22,806	7,899	7,937	6,791	136	6,394	59,802
Losses	261	472	2,401	755	967	777	14	732	6,379
Total Requirements	3,790	4,782	25,207	8,654	8,904	7,568	150	7,126	66,181
1965									
Farm	163	606	300	167	1,321	1,592	36	863	5,090
Residential	979	2,163	8,041	2,866	3,663	2,630	52	2,313	22,688
Commercial	435	1,342	8,098	1,404	1,706	1,935	39	1,487	16,531
Industrial	3,204	1,682	13,246	6,554	4,080	2,937	9	4,141	35,953
Street Lighting	59	98	441	97	167	135	3	69	1,068
Other	130	155	2,240	148	322	292	18	157	3,458
Total	4,970	6,046	32,366	11,336	11,259	9,571	207	9,030	84,785
Losses	333	628	2,959	923	1,139	972	18	906	7,878
Total Requirements	5,303	6,674	35,325	12,259	12,398	10,543	225	9,936	92,663
1970									
Farm	210	940	500	290	1,970	2,550	140	1,300	7,900
Residential	1 340	3,220	12,580	4,740	5,580	4,070	70	3,520	35,120
Commercial	610	1,950	12,500	2,120	2,540	2,770	40	1,980	24,510
Industrial	4,540	2,270	18,700	9,250	6,540	4,540	10	5,950	51,800
Street Lighting	80	140	630	120	260	190	10	100	1,530
Other	170	220	3,080	250	480	450	20	220	4,890
Total	6,950	8,740	47,990	16,770	17,370	14,570	290	13,070	125,750
Losses	450	950	4,310	1,350	1,590	1,420	30	1,200	11,300
Total Requirements	7,400	9,690	52,300	18,120	18,960	15,990	320	14,270	137,050
1980									
Farm	340	1,680	790	740	4,030	4,910	280	2,600	15,370
Residential	2,480	6,020	27,140	10,540	12,360	8,040	140	7,300	74,020
Commercial	1,170	3,640	26,880	4,600	5,160	5,240	80	3,710	50,480
Industrial	9,080	4,190	34,800	19,400	15,910	8,890	40	12,240	104,550
Street Lighting	120	260	1,160	220	550	370	10	200	2,890
Other	260	410	6,300	700	1,020	780	40	440	9,950
Total	13,450	16,200	97,070	36,200	39,030	28,230	590	26,490	257,260
Losses	840	1,670	7,930	2,750	3,030	2,530	40	2,040	20,830
Total Requirements	14,290	17,870	105,000	38,950	42,060	30,760	630	28,530	278,090

for cooling per kwh than conventional steam plants, but it is thought that from prototypes now planned or under construction, future designs will tend to overcome this disadvantage.

Present thinking places the nuclear market in areas where competing fuel costs run above 25 cents per million Btu which would include a major portion of the UMRB Power Region. Typical fuel costs for some of the larger plants in the region are shown in *Table P-102*.

Because of the confidence displayed by a number of utilities through commitments in the billions of dollars for nuclear reactors in recent years, there can be little doubt that electrical generation from nuclear power has become established. Although nuclear capacity represents less than 1/200 of the 1966 generating capacity, it accounted for more than half of the new capacity ordered in 1966. Over 75,000 mw of nuclear capacity is in operation, contracted for, or announced as planned for operation by 1975. The Commonwealth Edison Company, which is presently deriving the benefits of unit trains and a mine-mouth generating plant, has contracted for over 4,700 mw of nuclear capacity on a competitive basis. This utility, which accounts for approximately one-third of the generating capacity

Table P-101

Projections of Electric Power Requirements Supplied by Electric Utilities for the Upper Mississippi River Basin Power Region

PSA	Energy, million kwh	Growth Rate, %	Energy, million kwh	Growth Rate, %
	1960		1965	
12	3,790	5.7	5,303	6.9
13	4,782	6.6	6,674	6.9
14	25,207	5.5	35,325	7.0
15	8,654	5.1	12,259	7.2
16	8,904	6.9	12,398	6.8
17	7,568	6.8	10,543	6.9
26	150	8.4	225	8.4
40	7,126	6.5	9,936	6.9
Total	66,181		92,653	
	1970		1980	
12	7,400	6.9	14,290	6.8
13	9,690	7.7	17,870	6.3
14	52,300	8.2	105,000	7.2
15	18,120	8.1	38,950	8.0
16	18,960	8.9	42,060	8.3
17	15,990	8.7	30,760	6.8
26	320	7.6	630	6.9
40	14,270	7.5	28,530	7.2
Total	137,050	8.1	278,090	7.3
	1990		2000	
12	25,150	6.2	41,810	4.8
13	32,270	6.1	50,560	4.6
14	195,000	6.4	311,800	4.8
15	75,630	6.9	120,940	4.8
16	83,640	7.1	134,920	4.9
17	60,040	6.9	96,850	4.9
26	1,210	6.7	1,910	4.8
40	54,960	6.8	89,530	5.0
Total	528,900	6.6	848,350	4.8
	2010		2020	
12	60,700	3.8	81,830	3.0
13	73,420	3.8	98,960	3.0
14	452,740	3.8	610,300	3.0
15	175,600	3.8	236,710	3.0
16	195,900	3.8	264,070	3.0
17	140,620	3.8	189,550	3.0
26	2,820	3.8	3,790	3.0
40	130,000	3.8	175,240	3.0
Total	1,231,800	3.8	1,660,450	3.0

in the UMRB Power Region, will be supplying 40 percent of its electricity from nuclear plants by 1972, and possibly 60 percent by 1975, with savings estimated at 5 to 10 percent over alternative methods. Consideration of air pollution, reliability, maintenance and adaptability to improvement were other factors contributing to the decision.

Because of the unprecedented surge in orders for nuclear capacity, estimates of future installations have continually been increased. The current Atomic Energy Commission projection is between 120,000 to 170,000 mw of installed nuclear capacity by 1980, and other estimates run between 150,000 to 200,000 mw. Although the share of nuclear capacity might be about 30 percent, the energy production would be a greater percentage since this

Table P-102

Typical Fuel Costs for the UMRB Power Region — 1967

PSA	Plant	State	Utility	Fuel Cost, cents per million Btu
12	Bailly	Indiana	Northern Ind. P.S. Co.	25.9
12	D.H. Mitchell	Indiana	Northern Ind. P.S. Co.	26.1
13	Nelson Dewey	Wisconsin	Wisconsin Pwr. & Lt. Co.	26.5
13	Oak Creek	Wisconsin	Wisconsin Elect. Pwr. Co.	29.8
14	Crawford	Illinois	Commonwealth Edison Co.	28.2
14	Joliet	Illinois	Commonwealth Edison Co.	22.9
14	Kincaid	Illinois	Commonwealth Edison Co.	20.1
14	Will County	Illinois	Commonwealth Edison Co.	28.7
15	Meramec	Missouri	Union Electric Co.	21.2
15	Sioux	Missouri	Union Electric Co.	21.5
15	Venice	Illinois	Union Electric Co.	22.0
16	Alma	Wisconsin	Dairyland Power Coop.	26.7
16	Black Dog	Minnesota	Northern States Pwr. Co.	27.9
16	Riverside	Minnesota	Northern States Pwr. Co.	27.9
17	Des Moines	Iowa	Iowa Power & Light Co.	27.2
17	Riverside	Iowa	Iowa-Illinois Gas & Elect. Co.	25.2
40	Coffeen	Illinois	Central Illinois Publ. Serv. Co.	17.7
40	Grand Tower	Illinois	Central Illinois Publ. Serv. Co.	22.3
40	Hennepin	Illinois	Illinois Power Co.	24.7
40	Wood River	Illinois	Illinois Power Co.	18.6

capacity would be used mainly for base load. Virtually all large generating plants will be nuclear by the year 2000 according to AEC forecasts.

A tabulation of nuclear plants that are in operation or that have been scheduled in the UMRB Power Region is given in *Table P-103*. It is readily apparent that the major activity has been in PSAs 13, 14, 16, and 17 where fossil fuel costs are relatively high. PSA 14 also presents large loads, which permits the use of large units where nuclear plants are more competitive. Nuclear plants have not been contracted for in PSAs 15 and 40, where fairly low fossil fuel costs prevail but extensive evaluation studies are being made. A nuclear unit was planned in PSA 12 but then dropped in favor of purchased capacity. This delay could make the procurement of a larger unit practical in the future.

Based upon the considerations discussed, the purchases now being made, and the conditions existing in each PSA related to the feasibility of nuclear power, estimates for nuclear power supply are shown in *Table P-104* as being 33 percent of the total thermal supply for the year 1980, 70 percent in 2000, and 81 percent in 2020. Forecasts to the year 2020 involve considerable speculation and as such should allow for the realization of other forms of generation now being developed. Such an allowance of 5 percent was made for the year 2000 and 15 percent for 2020. An estimate of nuclear and exotic capacity as a percentage of the total capacity for the USA and UMRB is shown graphically in *Figure P-60*.

The hydroelectric supply from known sites for the UMRB Power Region in 2020 is estimated at less than 2 percent including imports of 800 mw in 1980 and 1200 mw beyond the year 2000 from the Nelson River project in Canada. A detailed study of the hydroelectric potential is contained in the "Report of the Hydroelectric Power Subcommittee to the Power Advisory Committee" dated January 1966. It is to be noted, however, that for purposes of this Type I study the selection of possible future hydroelectric installations was made on the basis of judgment rather than on economic analysis. It was felt that the net power transfer across the Basin boundary for the years 1980, 2000, and 2020 should be considered zero except for the above small import of Canadian power. Transfers will occur at specific points throughout the years, but could vary with time in either direction. In addition to being difficult to evaluate, the amount in question would not significantly affect the overall situation.

The large scale conversion of energy sources today to electrical energy is very inefficient in spite of all of the progress that has been made. An amount of energy in the form of heat greater than that which is used is lost in the process. Allowing for electric energy requirements in 2020 approximating 18 times the present use, we must be concerned with dissipating an amount of energy equal to more than 25 times that which is now being generated, unless more efficient methods of generation become practical. The common practice has been to absorb the greater

Table P-103
Scheduled and Installed Nuclear Capacity in the UMRB Power Region

PSA	Plant or Location	Utility	Capacity, Mw	Scheduled Operation
13	Genoa	Dairyland Power Cooperative	50	1967
13[a]	Kewaunee	Madison Gas & Electric Co. Wisconsin Pub. Service Co. Wisconsin Power & Light Co.	527	1972
13[a]	Point Beach No. 1	Wisconsin Michigan Power Co.	455	1970
13[a]	Point Beach No. 2	Wisconsin Michigan Power Co.	455	1971
14	Dresden No. 1	Commonwealth Edison Company	200	1960
14	Dresden No. 2	Commonwealth Edison Company	715	1969
14	Dresden No. 3	Commonwealth Edison Company	715	1970
14	Zion No. 1	Commonwealth Edison Company	1,100	1972
14	Zion No. 2	Commonwealth Edison Company	1,100	1973
16	Elk River	Rural Coop. Power Association	22	1963
16	Monticello	Northern States Power Company	472	1970
16	Prairie Island No. 1	Northern States Power Company	550	1972
16	Prairie Island No. 2	Northern States Power Company	550	1974
17	Quad Cities No. 1	Commonwealth Edison Company	715	1970
17	Quad Cities No. 2	Iowa-Illinois Gas & Electric Co.	715	1971
17[a]	Cooper	Consumers Public Power District[b]	800	1972
17	Cedar Rapids No. 1	Iowa Electric Light & Power Co.	550	1973
17	Cedar Rapids No. 2	Iowa Electric Light & Power Co.	550	?

[a] These plants are located outside of the UMRB Power Region but will supply loads within the Region.
[b] Will also supply Iowa Pwr. & Light Co. through 345 kv transmission.

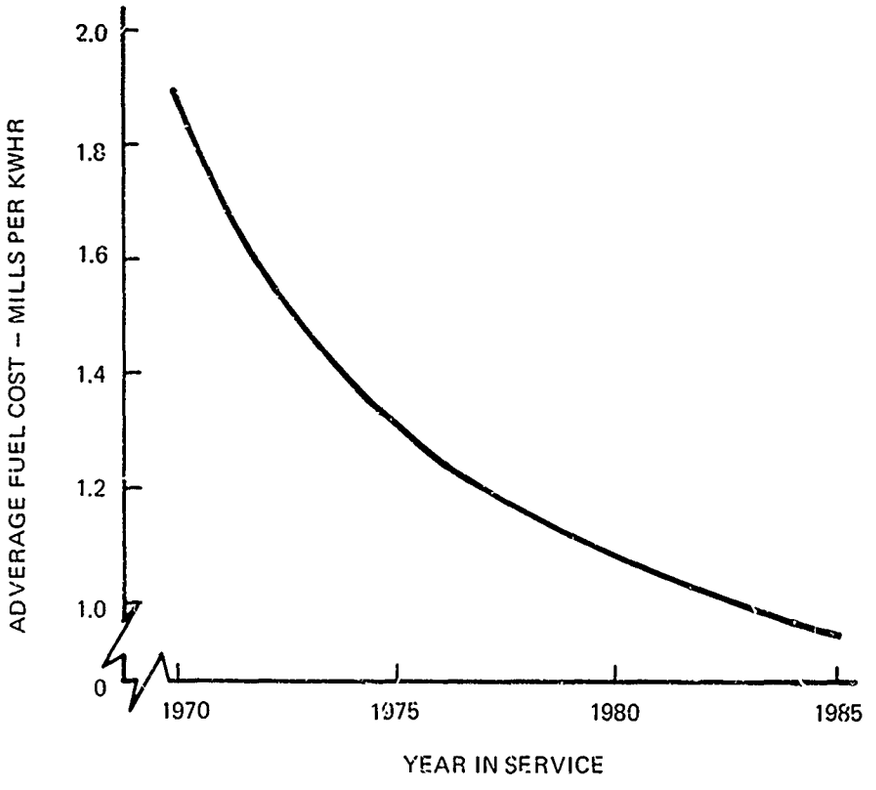

Figure P-59. Estimated nuclear fuel costs.

Table P-104

UMRB Power Region Projections of Electric Utility Power Supply by Types for Power Supply Areas (megawatts)

PSA	Total Required	Hydroelectric Including Imports	Thermal		
			Total Required	Nuclear[a]	Others[a]
1980:					
12	2,780	–	2,780	1,050	1,730
13	3,640	177	3,463	1,000	2,463
14	22,580	63	22,517	11,000	11,517
15	9,780	1,278	8,502	800	7,702
16	7,980	1,291	6,689	3,000	3,689
17	6,420	88	6,332	2,000	4,332
26	150	1	149	–	149
40	6,370	2	6,368	–	6,368
Total	59,700	2,900	56,800	18,850	37,950
2000:					
12	7,990	–	7,990	6,350	1,640
13	10,110	744	9,366	6,700	2,666
14	66,630	116	66,514	56,000	10,514
15	29,730	1,678	28,052	12,700	15,352
16	25,560	1,751	23,809	19,400	4,409
17	18,910	156	18,754	11,400	7,354
26	450	1	449	–	449
40	18,520	2	18,518	8,400	10,118
Total	177,900	4,448	173,452	120,950	52,502
2020:					
12	15,460	–	15,460	12,600	2,860
13	19,570	744	18,826	15,300	3,526
14	128,830	166	128,714	105,000	23,714
15	57,750	1,678	56,072	45,600	10,472
16	48,830	1,751	47,079	38,200	8,879
17	36,300	156	36,144	29,400	6,744
26	860	1	859	–	859
40	35,920	2	35,918	29,200	6,718
Total	343,520	4,448	339,072	275,300	63,772

[a] An allowance is included for noncondensing types in each as follows:
1980 – none
2000 – 4,500 Mw
2020 – 26,000 Mw

part of these losses into a large body of natural water. Other methods are available, such as the use of cooling towers or cooling ponds for dissipating the heat to the air, but only at an appreciable increase in cost and with a continuing need for replacement of the water lost through evaporation.

When considering plant sizes of 5,000 to 10,000 mw indicated for the future, it is necessary to find huge "dumping grounds" for this waste energy. Fortunately, the UMRB Power Region includes, or is in the proximity of two places that could possibly accommodate these plants and still avoid excessive thermal pollution. These sites would include the shores of the Great Lakes and the lower one-third of the Mississippi River in the UMRB Power Region.

Water availability is a basic criterion in determining the location of thermal generating plants. Fuel can be transported to the plants, and electrical energy can be carried away from the plants to the load centers. This arrangement is flexible, and an economic balance can be ascertained between the relative distances of fuel and electrical transportation, either of which may approach zero. Water for cooling purposes, however, cannot be moved any great distance economically. Therefore, the water resources within the Basin will be an important factor in the selection of sites for the generation of electric power.

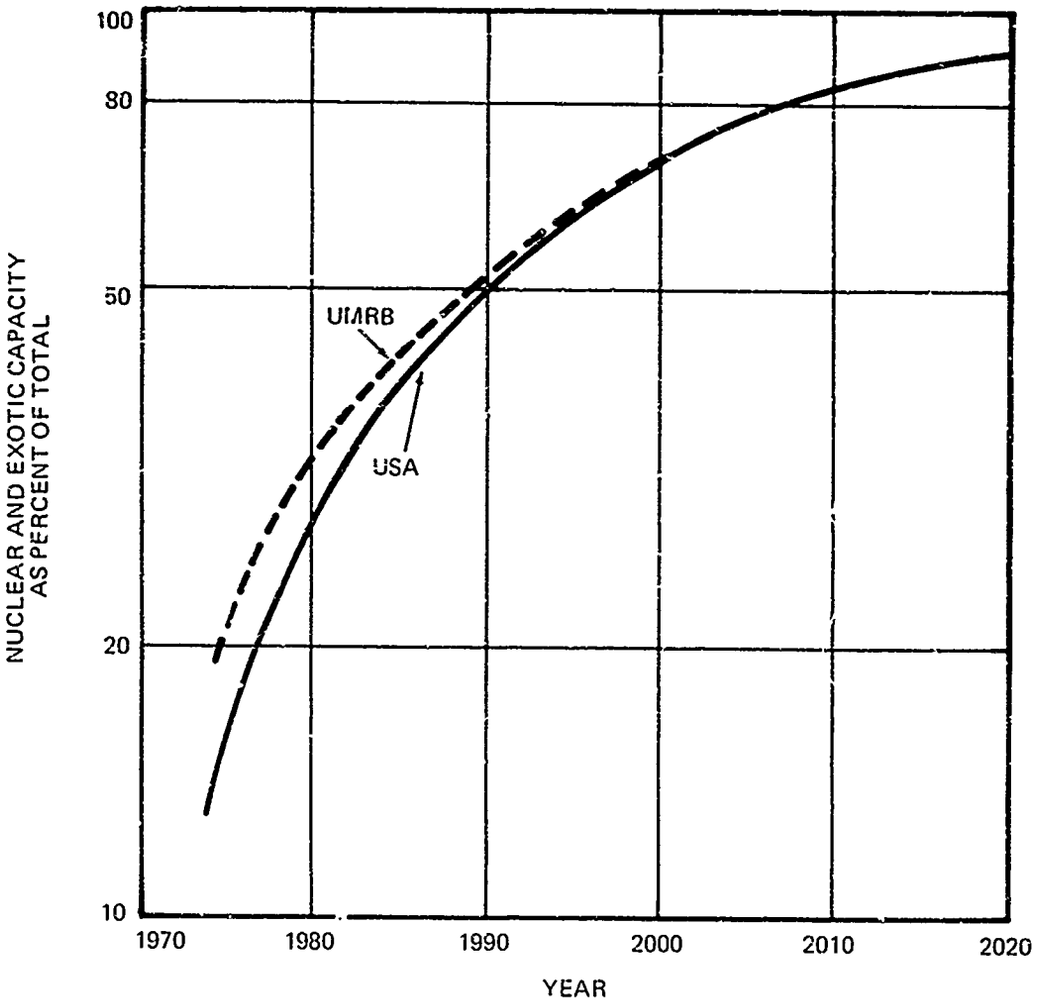

Figure P-60. Estimated nuclear and exotic capacity.

Section 7
METHODS FOR USE OF ECONOMIC BASE STUDY AND PROJECTIONS IN WATER RESOURCE PLANNING

The purpose of the economic base study and projections in this study is to provide guides to aid in projecting future water requirements. The future water requirements in turn are the points of departure in the development of a water resource plan.

The statements included in this part of Appendix P summarize the approaches used in the application of the economic base study and projections to water resource planning by the participants in the Upper Mississippi River Comprehensive Basin Study. The statements are printed as furnished by each participant.

7.1 Mineral Resources, Bureau of Mines*

Water is, and will continue to be, a vital tool in the mineral industry. The emphasis toward higher quality products and the utilization of lower grade materials has been a major influence in the increasing use of water. Water use in the future is expected to increase with the growth of the mineral industry. For most commodities water use was projected at the same ratio of water use per ton of product for all projected years. For some commodities, predicted technological developments will increase water requirements. The water ratio in these cases was adjusted accordingly.

Sand and gravel is a mineral industry likely to require an increase in the water ratio for processing. The demand for cleaner and better quality sand and gravel has been steadily increasing over the past 20 years. Construction specifications are requiring closer tolerances on raw materials. To meet many of these requirements, the aggregate industry must beneficiate its product through the use of water. Based on this trend, the water ratios per ton of product for the aggregate industry have been increased 1 percent for every 10 years in all projections after 1970. This increase in water-use ration is expected to affect sand and gravel and crushed stone industries.

The depletion of direct-shipping iron ores and the increase of beneficiation practices have had a significant effect on the water requirements in the iron mining industry. Sixty-three percent of the iron ore shipped from Minnesota in 1965 was from "natural ores" and 37 percent from beneficiated taconite. The predictions are that, by 1970, over 60 percent of the iron ore from Minnesota will be beneficiated taconite and will increase to over 90 percent by 1980. Because of these developments, water use ratios for the period 1970–2020 in the Basin are based only on taconite operations.

The coal industry has, during the past 15 years, made great advances in obtaining a higher quality product through beneficiation. Most beneficiation is by washing. In 1949, only 35 percent of the Nation's coal production was beneficiated and in 1964, 64 percent was beneficiated. During the same period production increased 9 percent while new water intake increased 7.04 percent. Coal spokesmen imply that this new water intake was a result of production increase and that the added need for water for beneficiation was obtained through greater recirculation. Based on this assumption, future water requirements in the coal industry in the Basin were increased proportionately with coal production. As there are no foreseeable radical technological developments in coal preparation, new water, discharged, or used-water ratios have not been altered. Recirculation ratios, however, were increased 1 percent per every 10 years in all projections starting in 1970.

The water data from the Bureau of Mines 1962 mineral industry water canvass was used to determine water ratios per ton of selected mineral product for each plan area. These ratios were applied to the 1960 production to arrive at the water use in the mineral industry for that year. *Table P-105* shows the weighted average water use ratios for the entire Basin.

Due to unusual water use patterns and other factors, the water use data used in the Upper Mississippi River Comprehensive Basin Study may not coincide with the national pattern.

7.2 Water Supply and Water Quality Control, Federal Water Pollution Control Administration†

The purpose of this subsection is to explain how the projections of population and industrial growth provided by the National Planning Association (NPA) will be used by the Federal Water Pollution Control Administration (FWPCA) in developing the future water supply and quality control needs in the Upper Mississippi River Basin.

*Used to develop projections of water requirements for UMRCBS Appendix F, Mineral Resources.

†Used in translating economic base study data into demands for water supply and quality control for UMRCBS Appendix H, Water Supply and Quality Control.

Table P-105

Upper Mississippi River Basin Average Water Use Ratios – 1960

(gallons per ton of product)

Mineral Commodity	*New Water Intake*	*Water Discharged*	*Water Recirculated*	*Water Consumed*
Crushed limestone	33	31	22	2
Dimension limestone	3,020	2,985	1,650	35
Coal	104	95	450	9
Sand and gravel	162	157	187	4
Iron ore	489	379	1,409	110
Taconite	197	121	1,471	76
Zinc	13,773	13,739	6,886	34
Natural abrasives	94	91	0	3

Basically, the general method seems quite simple. From NPA projections of total population and Economic Research Service projections of farm population, the urban and rural nonfarm population of Plan Area 12 in the year 2020 can be derived as "X" number of people. Available data indicate that the water use in that plan area in 2020 will be "Y" gallons per capita per day (gpcd). Therefore, the municipal water use in Plan Area 12 in 2020 will be XY gallons per day. If the same elementary manipulation could be performed for industrial water, and these totals added to those provided by other agencies for agricultural and power requirements, a table could be prepared showing total water needs for Plan Area 12 in 2020. This would be a quantitive estimate, without regard to quality requirements.

However, this type of oversimplification would not meet the needs of the study. Of course, the total water needs of the future need to be known. Framework plans are to be defined in terms of gross storage requirements, with time and general geographic distributions, and in general reaches of stream (20 to 50 miles) where increased low flow and/or decreased pollution loads are indicated for water quality improvements at target dates in the future. This may involve projecting needs for units of population as small as villages or for a single industrial plant, if it is a large water user or waste producer.

Herein lies the crux of the problem. The NPA population and industrial predictions for the plan areas must be disaggregated down to the smaller units required for a stream reach, and the future water demand must be determined. In order to use the population projections, the future water usage is needed on a gpcd basis. To use the industrial projection, the future water usage on an employment, value added, or unit of product basis is required.

This disaggregation of population and industrial projections, and prediction of future water use is where a good share of the work lies. The calculations are largely empirical and are tempered with professional judgment and common sense.

The methodology is expected to permit a clear, orderly, and reasonable analysis and presentation of existing and expected conditions for support of water demand projections.

For the purposes of this study, the demand for water has been divided into five general classes. (1) Municipal, (2) Industrial, (3) Agricultural, (4) Power, and (5) Mineral Resources. It is obvious that the determining factor in this classification was the water use.

The municipal water demand includes residential, commercial, public, and those industrial uses which can reasonably be reflected in a per capita use figure. "Unaccounted-for" water is considered under this class, as leaks and other uncontrolled losses can be expected to be part of municipal demand. Under this class, Federal and State installations, are also included, although some of these installations have industrial water use.

The industrial water demand includes the demands for water supply exerted by the principal water-using industries (excluding the mineral resources group). This demand can be related to industrial employment, value added by manufacture, or units of production. If an appreciable amount of industrial demand is met by a municipal water supply system, it will be considered separately.

The agricultural water demand includes the following uses. (1) rural domestic, (2) livestock and fowl watering, and (3) irrigation. Each of these uses can be developed on a unit basis and correlated with future projections.

The power water demand can be either hydroelectric or thermal-electric. The water demand for thermal plants can be expressed on a unit basis.

The mineral resources demand can also be expressed on a unit of production basis.

Of the five general classes of water use, the development of municipal and industrial water supply is of great concern. The agricultural water demands are being assessed by agencies in the Department of Agriculture, the power demands by the Federal Power Commission, and the mineral resources demands by the Bureau of Mines.

The general steps in the methodology used to project municipal and industrial water supply are the same. Available past and present water-use data will be collected. The comparison between the past and present may, if

there is an adequate period of record, indicate the trend of future water demand. After consideration of the variables which affect municipal and industrial water demands, and study of the indicated trend, the future water use will be projected on a gped basis for municipal demand, and on a per employee or unit of production basis for industrial demand.

7.2.1 Municipal Demand

Historical water demands are obtained from state and local records of previous years. Per capita rates are expected to be developed for each plan area for selected past years. These milestones, plus the present demand will indicate a trend.

Present municipal water use is available in the *1963 Inventory of Municipal Water Facilities*, PHS Publication 775 (Revised), Volumes 5 and 6. Printouts of this data from publication are available, arranged alphabetically by communities, by counties, and by plan areas. A listing of all municipalities and Federal and State installations in the plan areas by counties will be prepared. The list will contain the following information. (1) present gped usage, (2) types of treatment used in the Basin (this gives an indication of the quality of the surface and ground water, (3) sources of supply, whether surface or ground, (4) estimated firm yields of the sources of supply, and (5) whether the municipal systems are metered.

In addition, the location of all municipalities plus Federal and State installations having water supplies will be plotted on a map of the plan area. This map will show the river system of the Basin, so that the relationship of the communities and installations to surface water supplies will be shown.

This map, used in conjunction with the USGS map of underground aquifers will also indicate the probable yield for communities having ground water supplies. The symbols used to indicate the locations of the water supplies in the Basin will indicate whether it is a surface or underground supply.

In determining the *future* municipal water demands, several independent variables will be considered. These variables are. (1) population served, (2) general state of the economy, (3) standard of living of the population served, (4) rank (with respect to size) of population served, (5) climate, (6) price of water, and (7) extent of metering.

Of the variables, municipal water demand is most affected by the number of persons served. The demand is expressed in gped and the other variables are investigated as to their effect on this per capita demand.

The economic base study is expected to provide some insight into. (1) general state of the economy and (2) standard of living of the population served. The remaining variables can be evaluated from readily available data. (See subsection 7.2.1.1 for a more detailed analysis of these variables.)

Also considered will be previous studies and reports on this subject, such as the Senate Select Committee Reports. The FWPCA Great Lakes-Illinois River Basins Project will be consulted also on methods of projection, as well as projections made in that project for Plan Areas 5A and 5B.

The next step is that of disaggregating the plan area population projections provided by NPA. Subtracting the rural farm population projections supplied by Economic Research Service (ERS) from the NPA projections will leave the nonfarm population, which is the combined total of the urban and rural nonfarm population. It is this nonfarm population that will have to be broken down to a county or stream reach (20 to 50 miles) level. Some populations may have to be projected on a city (SMSA) level. The total of all projections in a plan area will equal the NPA total nonfarm projection for that plan area.

Some working figures are expected to be provided by NPA in county and metropolitan areas. It may be that every county will not have to be predicted. Some counties in the plan areas do not have any large towns, and a preliminary inspection of the data may reveal that there is no need to go further. However, the water supply is needed for the second phase of the study when water loadings to the stream are estimated. Judgment will have to be exercised in determining the size of the smallest area used in the disaggregation.

In summary then, the methodology for projecting municipal water needs for each plan area for the years 1980, 2000, and 2020 will involve. deriving gped projections of demand, population projections for each county or stream reach in the Basin, multiplying population projections by gped projections to get unit needs, and totalling the individual unit needs to get gross municipal needs.

7.2.1.1 Future Municipal Water Demand Variables

(1) Population Served. Municipal water demand is most affected by the number of persons served. Municipal demand is usually expressed as a ratio in gallons per capita day (gped). The other variables should be investigated as to their effect on per capita demand.

(2) General State of Economy. Examiners of historic municipal water demand data (available from local water works personnel or state health department) should consider the state of the economy at the time the demands were made. If possible, the demands should be standardized to reflect conditions which are

assumed in the economic forecasts. For example, if an expanding economy is forecast, adjustment of historic per capita demand to a standard base might be undertaken to establish a possible trend resulting from this expansion in the economy.

(3) Standard of Living of the Population Served. Standard of living can be expressed in many ways. One indication is consumer buying power as expressed in *Sales Management Magazine's* Survey of Buying Power issue (which provides indexes of buying power and sales activity, together with various income data). These data could serve as a basis for evaluation of the effect of this factor in historic data, while projections of this factor could serve as a guide for demand forecasts. (Existing theory is that municipal water demand is proportional to standard of living within limits.)

(4) Rank (with respect to size) of the Population Served. Various water supply planners have indicated that per capita water demands are influenced by the extent of the population served, i.e., large city demands are of a different magnitude (greater) than that of a small town. After correcting for the other factors which may influence municipal water demands, this factor should be examined. (It may be that the growth of a city and an expanding economy are coincidental.) Such effects should be considered before projecting per capita water demands on the basis of the magnitude of population to be served. Population density effect on water demand may also be considered in this factor or examined separately. (Existing water works practice tends to utilize population density in setting up distribution system design.)

(5) Climate. Climate's effect on municipal water demands can be investigated by use of the following indexes:

(a) Rainfall (inches/year).

(b) Net-moisture deficiency (precipitation, minus runoff, minus potential evapotranspiration).

(c) Climate factor –

$$\frac{\text{(Rainfall times average sky cover)}}{\text{(Days of rainfall greater than or equal to 0.01 inches)}}$$

The climate parameters can be used to guide or set up maximum projected demands since water supplies will be required to meet anticipated variations in demand due to climate. Maximum (yearly) demand for water supply is used for projecting requirements, since this is the quantity needed to satisfy critical demands.

(6) Price of Water Supply. Investigation of the effect of price on municipal water demand should be investigated in concert with the other listed parameters which could affect water demand. Historic water demand data and total cost of supply could serve as a guide to adjustments for this factor. Projections of the price of water would be useful in application of this factor for forecasting water demand.

(7) Accuracy of Measurement of Amount of Metering. This factor must be considered in reviewing historic data. For instance, often only estimates of pumpage are available. These cannot be given as much weight as metered demands. Use of demand data from unmetered system leads to an endorsement of water supply waste if this demand is treated as bona fide for projection purposes. The demand in this case is for service only, without regard for the quantity required. Further in this regard, historic demand data should be adjusted to exclude an unrealistic amount of "unaccounted for water," (not a demand) if projections are to reflect prudent use of municipal supplies. Current practice sets reasonable loss and waste as 20 percent of distribution system input.

7.2.2 Industrial Demand

The determination of industrial water demands requires two items: NPA industrial projections of employment or units of production, and future water demand in gallons per employee per day (gped) or gallons per unit of production (gpup).

Data on *past* industrial water usage are rather scant. A report, "Future Water Requirements of Principal Water-Using Industries" printed for the use of the Select Committee on National Water Resources, does give some information on the 1954 to 1959 period. The data show that during these years, on a national level, the number of employees increased, as well as the water use per employee, in four major water-using industries. These are: iron and steel; chemical and allied products; pulp, paper and products; and food and beverages. During this period, with the exception of the pulp, paper and products group for which data are not given, the water use per unit of production decreased. These same trends were evident on a regional basis, with the exception of pulp, paper and products, where the water use per employee stayed the same.

Generally speaking, quantities of industrial water *presently* used by the various industries in the United States are not known with any degree of accuracy. Available data are very meager, and in many cases the literature provides conflicting data. To date it appears that the 1959 U.S. Census of Industrial Water Use is the best source of the information needed for present industrial water demands.

However, the published Census data are too broad a scale for use. The Bureau of the Census has been contracted to rework two of the tables in the Census of Industrial Water Use. These are "Water Used by Manufacturing Establishments by Purpose of Industrial Use for States by Industry Groups" and "Water Used and Discharged by Manufacturing Establishments, by Source of Intake and Point of Discharge, by States, by Industry Groups." They will furnish the data by SIC numbers, for counties where disclosure regulations permit, and at least for the plan area level.

Industrial plant census data from McGraw-Hill Company have also been purchased. For each plant listed, the McGraw-Hill census provides: (1) name, (2) address, (3) plant size (employment, actual and group), (4) primary product by SIC number, and (5) secondary product by SIC number. A set of IBM cards will be produced for all counties (except Illinois River Basin counties) in the study area. A computer program is available to print out the data geographically, and is expected to provide a list of names and addresses, by 4-digit SIC numbers, by counties and by plan areas from these cards. This will be used as a basic check list.

McGraw-Hill is also providing a tabulation of employment totals by 4-digit SIC numbers by counties and by plan areas. From this list it will be possible to say that, in a given county or group of counties, in a given major water-using industry, there are X number of employees. From the check list, the industry names and addresses will be obtained. From the census data, the water use will be known in that industry in that plan area or county. A water-use per employee for individual industries can then be derived.

Industrial plant data is expected from other sources. Some states publish industrial water information and have made surveys of water use. There are other reports and surveys by specific industries that give water use. Some help is also expected from NPA, as they are making the industrial projections.

All of this industrial data will be assembled into various tables and maps. The information in the tables will be listed by SIC numbers by counties, and by county totals and plan area totals. A gped or gpup figure of water use should be obtained from these tables as well as the total water use by counties.

The location of the heavy water using industries will be plotted on a location map that will show their geographic relationship to surface water supplies. The symbol used will indicate whether the source of supply is municipal, surface, or underground.

Projections of industrial water use are probably the most difficult part of the industrial water study. It is impossible to foresee, even in the short run, what technological developments will occur in the industrial water use field. However, the demand for future industrial water supply will be affected by the following independent variables: (1) product manufactured, (2) manufacturing process, (3) amount of production, (4) rate of production, (5) cost of water supply, (6) cost of waste water disposal, and (7) amount of metering. (See subsection 7.2.2.1 for further explanation of these variables.)

Industrial water demand is most affected by the type of product manufactured. Currently 85 percent of the fresh water used in manufacturing industries, exclusive of electric power generation, contributes to the manufacture of: (1) Primary Metals – SIC 33; (2) Chemical and Allied Products – SIC 28; (3) Food and Kindred Products – SIC 20; and (4) Pulp, Paper, and Products – SIC 26.

Each of the variables will be examined to determine its effect on the two basic uses of industrial water supply: (1) cooling and air conditioning and (2) process and clean-up. The expected improvement in the efficiency of water use by large industrial users, i.e., increase in recirculation and other water-conserving practices, will be taken into account.

The end result of these considerations will be a series of projections for various major water-use industries. These projections will be on a gped or gpup basis for each plan area for 1980, 2000, and 2020.

After the future industrial water use figures have been produced the NPA projections of industrial employment and units of production will be disaggregated. (They will not be disaggregated down to a town level.) Generally a county will be the smallest unit for disaggregation. However, each plan area will be analyzed individually. Unless other considerations indicate differently, it will be assumed that the smallest unit for disaggregation will participate in the economic change in about the same ratio as in the past.

In the disaggregation, use will be made of the analusis of economic growth that will be given in the Economic Base Study. The reports and surveys of many local and State planning groups will also be reviewed.

In summary then, the methodology for projecting industrial water demands, for each plan area, for the years 1980, 2000, and 2020 will involve. deriving projections of water use on a gpcd or gpup basis, disaggregating NPA industrial projections to smaller geographic areas (counties or stream reaches of 20 to 30 miles), multiplying small area projections by gpcd or gpup to get small area needs, and finally adding the small area needs to get the total plan area industrial water needs.

7.2.2.1 Future Industrial Water Demand Variables

(1) Type of Product. Industrial water demand is most affected by the type of product manufactured. Currently, 85 percent of the fresh water used in the manufacturing industries, exclusive of electric power generation, contributes to the manufacture of: (1) Primary Metals–SIC 33; (2) Chemical and Allied Products–SIC 28 (29); (3) Food and Kindred Products–SIC 20; and (4) Pulp, Paper, and Products-SIC 26. (Thermoelectric power must also be considered in industrial water demand forecasting, but utilizes a slightly different rationale.)

(2) Process. The process used in the manufacture of the various products requiring large amounts of water is largely a function of the raw materials to be converted. An investigation of existing processes in the area under consideration together with an evaluation and projection of expected resources to be used can provide insight into anticipated conditions. An example of the situation where raw material plays an important part in the choice of process is the use of the kraft paper making process (with its many ramifications and modifications) for pulping southern soft woods and the production of kraft paper.

(3) Amount of Production. The amount of production (forecast) is a function of projected economic conditions and demand for the product together with the anticipated competitive position of the location under consideration. When the manufacturing process is oriented with respect to a resource, the projected availability of raw material can be used as a guide to the appraisal of this factor (methods provided in economic analysis).

(4) Rate of Production. The rate of production should be considered since manufacturing is often a seasonal operation in which a high rate of production (with accompanying high water demand) prevails for a limited amount of time. This should be considered in projecting demands on an average annual basis (as for reservoir storage).

(5) Price of Water Supply. The price of water supply can be used as a guide in determining future recycling practice. Transmission of water from a distant source is always possible; however, the cost of developing the distant source and moving the water to the point of demand may be more than the consumers are willing to pay. Recirculation is practiced when the total cost of conditioning and recycling is less than the cost to obtain water from an area where it is readily available.

(6) Cost of Waste Disposal. Under current (but not necessarily future) conditions, the cost of waste disposal can significantly limit demand. Very often current water demands do not embody this factor since adequate waste treatment and suitable disposal may not be provided by the user.

(7) Accuracy of Measurement or Amount of Metering. As in municipal water demand forecasting, the accuracy of measurement or amount of metering must be considered in reviewing historic data. A reasonable loss (quantity) in the water distribution system should be incorporated in the projected industrial water demand in accordance with local practice, since there does not appear to be an accepted percentage loss as in municipal demand.

7.2.3 Water Quality Control Needs

After the future M&I water supply demands have been estimated, the need for water quality control will be considered. This refers to the need for stream flows and regulation of such flows, to assimilate wastes remaining after accomplishment of adequate treatment and other methods of controlling wastes at the source. Therefore, we must determine the projected waste volume and character, degree of treatment, and flow in the receiving stream, to properly assess the quality control needs.

How does the Economic Base Study fit into this picture? The projected waste volume and character are functions of the projected water supply demand, which in turn depends upon population and industrial growth projections. The waste volume, or return flow, is that part of the water supplied to meet demands which is available for reuse. In determining the percentage of the municipal demand which will be returned to the stream, it is recognized that there is great variance around the country. Return flow percentages will be developed for each plan area, or perhaps groups of plan areas.

The best sources of municipal return flow data are sewage treatment plant records. These records may require adjustment to allow for the effect of such factors as whether the entire population served by the water system is also sewered, and whether there are industrial plants having private water supplies and contributing to the return flow. Other variables to be considered include nonmetered municipal use, storm water flows in a combined system, and infiltration of ground water into sewers, which may be the largest source of error.

The percent of municipal demand which is returned to the stream is not expected to vary appreciably during the projection period. Therefore, future return flows will be obtained by applying present-day return flow percentages to projected future municipal water demands.

The future quality of municipal return flows is not expected to differ greatly from present quality, with possible exceptions. If the industrial component changes, significant quality modifications may result. If water use in a given area is presently limited by a deficient supply, and this supply is augmented, use patterns may change, and with them, quality characteristics. However, domestic wastes will probably remain relatively unchanged and can be projected on a population basis with assurance of reasonable accuracy.

In general, we will assume that the principal waste constituents of municipal return flows will be mineral and organic solids, and that the per capita contribution will be 0.23 pounds of mineral solids and 0.25 pounds of ultimate biochemical oxygen demand (BOD) per day.

Projecting industrial return flow presents more of a problem than municipal flow. Plants producing identical products have been found to have significantly different water use patterns depending, at least in part, on differing operating practices, availability of water and geographical location. There is an even wider variation in quality characteristics of the return flow.

The two major categories of industrial water use are process water and cooling water. Quantitatively, cooling water return flow may vary from 10 percent to 90 percent of demand, depending on the degree of recirculation. Process water return flows do not vary as widely in percent of demand, and may be more clearly related to the products manufactured.

Some present return flow data are expected from the work being done for this study by the Bureau of Census. These should be on a small enough geographic basis to make them much more accurate than general industry averages. We also expect to get some return flow, per unit of product, from various reports that analyze specific industries. Some general literature on this subject is available for use as reference.

It is expected that the cost of water will increase in the future so that industrial use of water for cooling will be minimal, and that industrial water will be used primarily for process and general purposes (sanitary). In the absence of data more specifically applicable to the area under study, a series of percentages for different industries will be used that have been developed at the UMRCBS Washington headquarters. These are shown in *Table P-105*.

The quality of industrial return flows varies even more widely than the quantity. However, they can be characterized generally by their organic and mineral solids content. Here again we expect to get some quality information from special studies that have been made of specific industries. We will use information obtained by Great Lakes–Illinois River Basins Project in a number of industrial waste surveys, from which waste characteristics of certain industries have been developed.

For future projections of mineral solids in industrial waste, estimates prepared at UMRCBS Washington headquarters will be used for planning purposes. These are shown in *Table P-107* However, it is considered reasonable to expect that circumstances will force modification of organic solids by treatment methods capable of producing an effluent having a BOD equivalent to that of municipal sewage with 90 percent BOD removal. Hence, a single value for the BOD of industrial wastes of 0.155 tons per million gallons of effluent regardless of the strength of the raw waste will be used for planning purposes.

7.3 Flood Control, U.S. Army Corps of Engineers*

Projected future needs for water and land in the Basin will provide significant opportunities for water resources development including flood control and stream regulation. For the purpose of projecting future flood damages in the Upper Mississippi River Comprehensive Basin Study, growth and development in the flood plain areas are evaluated on the basis of the general growth trend in the plan area where the flood plain is located. The projected indexes of change for the following selected major economic classifications, Rural Nonagriculture, Urban, and Transportation are based on the projections of total population, total personal income, per capita personal income and indexes of change for selected major water using industries in Basin plan areas for the years 1980, 2000, and

*Used in projecting future flood damages for UMRCBS Appendix I, Flood Control.

Table P-106

Future Industrial Waste Return Flow Percentages

Industry	*Return Flow, percent of intake*
Mining	56
Primary metals	23
Transportation	79
Stone, clay, and glass products	33
Food	88
Textile	81
Paper	90
Chemicals	65
Petroleum	90
Metal, leather	79
Lumber	90
Project type irrigation	35
Thermal electric power generation	90

Table P-107

Industrial Wastes
Estimated Mineral Solids Content
for Planning Purposes

Industry	*Return Flow, tons per million gallons*
Mining	12.2
Mining other than natural gas	12.2
Natural gas	12.2
Primary metals	12.2
Transportation	1.22
Stone, clay, and glass products	1.22
Food:	
Brewery	4.15
Cannery	10.6
Corn starch	7.45
Citrus fruit	12.3
Dairy	2.78
Edible oil	14.0
Meat packing	5.75
Poultry	1.34
Textiles:	
Cotton mill	2.35
Wool scouring	24.5
Paper	1.22
Chemicals:	
Organic chemicals	1.22
Inorganic chemicals	1.22
Petroleum refining	1.22
Miscellaneous:	
Metal fabrication	1.22
Lumber, others	1.22

2020. The historical projection base for flood damage data in the Basin are for the prices and conditions existing in the economic and demographic base year, 1966, except as noted in Appendix I, Flood Control, of the Upper Mississippi River Comprehensive Basin Study. Flood damages in the Basin are projected to reflect potential damages in future years, assuming existing flood protection to remain the same and the flood risk factor to remain unchanged.

The following subparagraphs outline in brief the rationale used in determining the projected indexes of change to be used in each of the selected major economic classifications.

(1) Rural Nonagriculture. Rural nonagriculture flood damages are expected to reflect the indexes of change of total population or in the case of areas with more favorable economic prospects the higher index of change of per capita personal income.

(2) Urban. The projected upward measurement of potential urban flood damages is the index of change of total personal income in the respective plan areas, and the more conservative measure of development would be per capita income for flood plain areas with a less vigorous economic base. Total personal income is considered a reasonable indicator of economic growth in an urbanized area as it reflects the relatively high yield historically of investment for capital and human resources in urban areas. Also the significance of important nonmonetary items are measured by the concept total personal income—chiefly, net rental value to owner-occupants of their homes and services furnished without payment by financial intermediaries.

(3) Transportation. The indexes of growth for transportation flood damages are based on an analysis of potential growth in key sectors of the economy which are the major sources of shipping receipts for the various forms of commercial transportation. These indexes were based on the projected change in the value of output of the production in UMRB plan areas for agriculture, mining, and manufacturing. The application of indexes of change will take into account the industry mix within the total flood plain of a plan area as well as the suitability of various modes of transportation to the particular type of economic base of the flood plain.

(4) Utilities. The general view held by the Federal Power Commission concerning potential flood damages to electric and gas utilities in the Basin is that the future damages will not significantly exceed the current level of damages to existing facilities. The degree of flood protection afforded new electric and gas utilities is deemed sufficient to protect for maximum probable flood conditions in the Basin.

A discussion with the Federal Water Pollution Control Administration resulted in agreement that the best approach to projecting future flood damages to sanitary and water supply facilities is a demand analysis of future needs for water and sanitary systems for the 1960 -2020 period.

7.4 Navigation, U.S. Army Corps of Engineers*

The vigorous agricultural and industrial economic base of the Upper Mississippi Region is highly dependent upon the low cost waterborne transportation on the Upper Mississippi River and the Illinois Waterway for the bulk commodities produced and consumed by the agricultural and industrial sectors of the region's economy. In 1964 the above-mentioned parts of the mid-America inland waterway transportation system carried commerce totaling 46 million tons on the Upper Mississippi River and 31 million tons on the Illinois Waterway. Projections of population, employment, personal income and selected industry output for the Basin, multistate region, and Nation, contained in this appendix, were utilized as guidelines in developing a low-medium-high range of projected waterborne commerce for each of eight major commodity groups.

Commodity groupings were developed on the basis of economic classification for analysis and projection of existing and future waterborne commerce on the Upper Mississippi River System as follows: selected grains; bituminous coal; petroleum and products; cement, stone, sand and gravel; iron ore, I and S products, industrial chemicals and sulphur; agricultural chemicals; other selected commodities; miscellaneous commodities; and waterway improvement material.

In addition to Appendix P projections, the basic procedure used for projections of future waterborne commerce included a trend analysis of historical traffic data, an analysis of the 1964 origin-destination study of waterborne commerce on the Upper Mississippi River system, and an interview program with representatives of major companies currently producing or consuming significant quantities of waterborne bulk commodities.

*Used in projecting future waterborne commerce on the Upper Mississippi River and tributaries for UMRCBS Appendix J, Navigation.

Several alternative assumptions were used concerning the future utilization of the various bulk commodities conducive to waterborne movement. Also, foreseeable technological developments in navigation facilities, which would change the competitive position of waterborne transportation, were evaluated relative to other forms of transportation. The projection ranges were developed to accommodate the many alternatives affecting transportation of bulk commodities. A detailed study of transportation costs and rates, although desirable, was not feasible within the scope and funds of a Type I Comprehensive Study. Several additional important economic variables affecting waterborne commerce are:

(1) the export demand for selected grains,
(2) the increasing development of nuclear power facilities with a resulting effect on fossil fuel requirements,
(3) the development of additional pipeline networks for petroleum and products,
(4) the location of new industries producing and/or requiring prospective waterborne commodities such as iron ore and iron and steel products and industrial and agricultural chemicals,
(5) alternative modes of transportation such as the unit train, and
(6) improvements of facilities for waterborne commerce on the Upper Mississippi River system such as a deepening of the existing 9-foot channel, extension of navigation season and lock and dam construction or replacement. The data and projections of this appendix were of special significance in relation to items (1), (2), and (4) of the preceding listing.

7.5 Recreation, Bureau of Outdoor Recreation*

This section discusses the methodology used by the Bureau of Outdoor Recreation in developing a recreation demand study for the various plan areas comprising the Upper Mississippi River study area. It also includes a brief discussion of various data inputs in addition to a brief summary of how demand will be related to present and future supply and need.

For the purposes of this study, recreation demand is defined as the total participation in general recreation activities which would occur if facilities were available. Demand, therefore, is made up of two components: (1) existing use of the facilities provided and (2) latent or unexpressed demand which is inherent in a population but not reflected in the use of existing facilities.

Generally speaking, use data is available but often unreliable for major facilities, and it is quite meager for smaller areas and private facilities. Latent demand, on the other hand, is not directly measurable because of its dependence on the individual desires of large masses of people. Therefore, indirect methods were used for measuring demand. Several primary factors influencing recreation demand provide an indication of present and future demand; namely, population change, mobility, income, and leisure time. Past trends indicate that increases in use were closely correlated to the composite of these primary factors, thus providing a basis for predicting future demand for outdoor recreation. Population and income provided by the economic base study provided the basic data for computing existing and projected demand.

Since demand is closely associated with people and their geographical distribution, a brief review of the Basin's population is pertinent. *Figure P-61* shows the basin boundaries and the Standard Metropolitan Statistical Areas (SMSA's) to indicate concentrations of population. Within the 18 SMSA's in the Basin are nearly 13 million people or 66 percent of the Basin's 19 million people (1960 census). Another 1.3 million persons live in small urban places and 5.2 million or 27 percent of the Basin's population is rural. Today, 73 percent of the people in the Basin are living in urbanized areas, and present trends point toward increasing urbanization for the future. To further emphasize this concentration of population, the Chicago, St. Louis, and Minneapolis-St. Paul SMSA's account for 54 percent of the Basin's population. These areas are not only the points of origin for the greatest demand, but they also represent the greatest deficiencies of usable resources available for outdoor recreation.

To measure demand as related to concentrations of populations, circles were overlayed on each SMSA--one 40 miles and the other 125 miles. These circles represent an average distance of travel to recreation facilities and they correspond with a day's outing and weekend use respectively. This method was used not to describe travel patterns to existing areas but to show where the demand would be focused if facilities could be provided.

Next, demand was apportioned to the various plan areas that fall within the zone of influence of the various SMSA's (*Figure P-61*). For example, Evansville, Indiana; Decatur and Springfield, Illinois; and St. Louis and Springfield, Missouri; all fall within 125 miles of the Meramec plan area and would therefore have some influence on

*Used in translating economic base study data into recreation demands for UMRCBS Appendix K, Recreation.

any facility developed there. Lacking more sophisticated techniques, demand was distributed, based on the proportion of the circles which fall within a plan area boundary.

Studies have shown that 60 percent of the demand would occur within the 40 mile day-use zone and another 30 percent would fall within 40 to 125 mile weekend-use zone. The remaining 10 percent would be assigned to long duration trips beyond the weekend-use zone. Therefore, demand was localized by applying these factors to the population affecting a specific plan area. The computed populations for the various SMSA's having an effect on the plan area were summed to provide an effective SMSA population. Lacking a point of origin for the non-SMSA population, it was added to the SMSA population giving a total effective population for that plan area.

The next step was to apply the modified participation rates for the various activities to the computed effective population. (Participation rate X effective population = activity occasion.) This provided an indication of present and projected demand for such activities as swimming, boating, camping, and other water-related and nonwater-related activities.

It is recognized that certain inaccuracies are inherent to a system using averages based on regional surveys, particularly in making long-term projections. However, this procedure appears to be significant for comparing present and future demand and for comparing the demand for certain types of activities within the various plan areas of the Basin.

The primary objective for incorporating the demand data into the analysis was to correlate demand with supply to determine what recreation facilities are needed and where they are needed. Supply data was obtained from the following sources:

(1) An inventory of public facilities conducted by the Bureau of Outdoor Recreation in 1964 for the Nationwide Plan. These data were supplemented by additional information on smaller cities collected by the various state agencies.

(2) An inventory of private recreation sponsored by the National Association of Soil and Water Conservation Districts.

Other data sources were reviewed and included where they improved the detail and accuracy of present and future supplies of recreation facilities. Although individual site investigations were not made, available information on proposed Corps of Engineers' reservoirs, Soil Conservation Service P.L. 566 projects, and Federal Power Commission licensed areas was included in the analysis. In addition, other Federal and State agencies were contacted in search of information on proposed and potential areas.

For present and future target dates, the Recreation appendix will show unmet recreation needs or the difference between available supply and demand (demand–supply = unmet needs). To convert both supply and demand to units of recreation days, conversion standards were developed to express acreage requirements per 1,000 population and use per acre per year (see Appendix K for details). This system of supply and demand was expressed graphically in terms of population density, resource availability, and highway accessability. The intent of this analysis is to define both quantitatively and spacially those priority areas requiring concentrated efforts and study to meet the recreation needs of the people in and adjacent to the Basin.

7.6 Power, Federal Power Commission*

Load forecasts for the Basin and surrounding areas have been completed to the year 1990 in cooperation with the utility industries operating in that area. These forecasts, which were prepared in connection with the updating of the National Power Survey, were used in the UMRCBS Report and Appendixes. The major utilities probably utilized economic indicators in forecasting their loads but such indicators as developed for the Water Resources Council were not available at the time the Guidelines for Updating the National Power Survey were prepared. Consequently, the projection of population utilized by the Federal Power Commission is about 4 percent higher than the Council's projection. Also, projection for GNP as of 1980 was about 5 percent lower than the Council's projection. The differences are well within normal estimating error limits. However, the FPC Washington staff will utilize the economic base data prepared for the Water Resources Council in final national projections of future power needs. As a matter of practical fact, very little success has been experienced in closely relating economic data to electricity use even on a national basis. However, as a part of the updating of the National Power Survey, an Advisory Committee on Load Forecasting Methodology has been appointed. This committee is undertaking some econometric studies looking toward a more sophisticated method of projecting future electrical loads. Perhaps some of this work and research will indicate ways of more meaningful utilization of economic indicators.

*Used to determine future power requirements for Basin Power Supply Areas in UMRCBS Appendix M, Power.

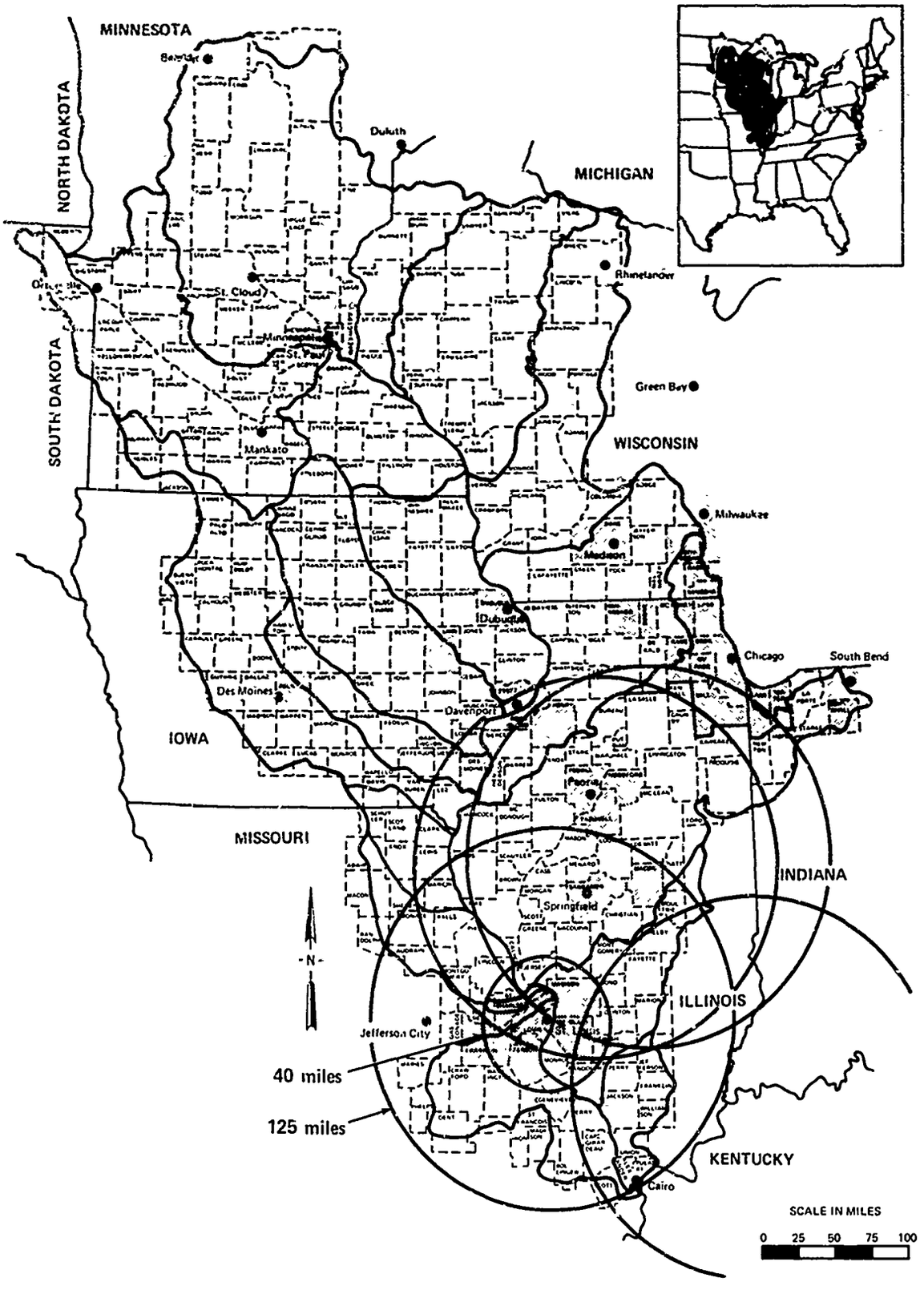

Figure P-61. Upper Mississippi River Basin recreation reference map.

7.7 Forest Resources, U.S. Forest Service*

The analyses of the timber resources ownership classes and timber products output provide the background necessary to determine the productivity of the forest areas and the extent to which they can meet further demands for the resources of water, wood, wildlife, and recreation.

Forests enclose or border most of the two million acres of water area in the Basin. They comprise 21 percent of the watershed, offer erosion and sediment protection to most major investments in water impoundments, minimize erosion and flooding, and are a significant factor in the quality and quantity of available water. The use and treatment of forest land in many watersheds determines to a large extent the quality, quantity, and dependability of the water supply in that watershed for all purposes: agricultural, domestic, municipal, industrial, and recreational.

Forests provide the most opportunity-laden areas for outdoor recreational activities. Location of the resource, the extent of public ownership, and the general condition of the resources offer additional tools to planners determining the abilities of the resources to meet the pressures of the future. The forest is a balance of resources, which, when managed creatively and sensibly can cope with recreational pressure and provide a continuing atmosphere of enjoyment for the visiting public.

Forest products industries have traditionally depended on high-grade timber for the largest part of their profits. The supply of prime timber continues to dwindle, timber prices have risen steadily, and rapidly increasing imports are capturing a significant share of hardwood markets. Analyses of the Forest Resource Tables indicate that the Basin has a plentiful supply of low and medium grade hardwood timber and these grades can be improved in our present stands through forest management.

The pulp and paper industry is a major water user. It is generally a nonconsumptive type use. Water use is largely confined to this forest industry, although limited quantities of water are also used in the production of lumber and wood products. These may have a significant bearing on local situations. The use of water by the pulp and paper industry may have an effect on downstream water use.

The pulp and paper industries are having the fastest growth of the wood-using industries. Eighty percent of the capital investments for the forest products industry, 86 million dollars, is attributed to the pulp and paper industry. Income for those persons employed in paper and allied trades was 349.4 million dollars in 1962. They depend on an adequate supply of water for continuous operation.

The water requirements for the industry was determined from data collected from the industries, information from trade sources, and resource data from the Forest Resource Tables. Not all firms queried responded with information on water use. The following methodology was developed to indicate total present and projected water requirements for processing paper and miscellaneous products in the Basin.

Present water requirements for the mills not reporting was determined by comparing product output of these mills to those mills reporting water intake. Water intake of the reporting mills was expressed in water use per ton of product per 24-hour period. Application of this figure to the production capacity of those firms not reporting provide an estimated total present water requirement.

In Appendix N, Table N-13 – Forest Resource Statistics – provides present and projected pulpwood products. These figures were converted to tons of pulp using one ton of pulp/1.5 cords of pulpwood. The mills use more pulpwood than is produced in the Basin and shown in Table 13. Therefore a factor based on the ratio between mill capacity and pulpwood production was determined to account for the imported pulpwood. This factor is 2.2.

Water use by the industry is expressed in gallons of water per ton of paper produced. A second factor of 2.3 was determined, based on a ratio between tons of paper and miscellaneous products produced and tons of pulp produced. This factor converts the water requirement for one ton of pulp to the water requirement for one ton of paper and miscellaneous products.

The water intake is determined to be 47,000 gallons per ton of paper or miscellaneous products produced. Projected annual water intake is then determined by multiplying each of the above factors by the conversion of cords of pulp (Table N-13 – Forest Resource Statistics) to tons of pulp. For example:

$$\frac{949{,}000}{1.5}\,(2.2)\,(2.3)\,(47{,}000) = 151 \text{ billion gallons}$$

Using this methodology the present and projected nonconsumptive water use in the pulp and paper industry in the Basin is as follows:

*Used in projections of forest activities for UMRCBS Appendix N, Agriculture.

Present – 151 billion gallons
1980 – 227 billion gallons
2000 – 321 billion gallons
2020 – 383 billion gallons

These figures represent water for process use only. They do not include water needed for pollution control. They are also based on the assumption that pulp input to product output remains constant.

The forest resource data are covered in detail in Appendix N, Agriculture. They supplement the other basic studies needed to achieve a balanced program necessary to provide an economic foundation for effective river basin plans.

7.8 Agricultural Drainage, Flood Protection and Irrigation, Economic Research Service*

In order to identify Basin water resource problems and to point out critical areas for further study, the Economic Research Service projected the potential changes in agricultural production and associated onfarm costs which could be expected if water resource developments for irrigation, drainage, and flood control were undertaken for the future time periods of 1980, 2000, and 2020. The study used a programming analysis to determine the most efficient agricultural production pattern for the Basin both with and without a water-resource program.

A more detailed discussion of the analysis for water and related land resource development potential for agriculture is contained in Appendix N, Agriculture. The following is a summary of that statement discussed in terms of flood control. A similar approach is applicable for drainage and irrigation.

Cost and yield information was developed for field and pasture crops within the Basin for the projection years By specifically identifying those soils subject to flooding, it was possible to determine yields and costs of production under two conditions. First, with present levels of flood protection, and second with total flood protection. Estimates of dollar crop and pasture damages and of numbers of acres subject to flooding were collected from the Soil Conservation Service for the upstream areas and from the Corps of Engineers for downstream areas. Damages to the various crops and pasture were linked to floods and flood frequency and time of occurrence in order to determine annual equivalent flood damages for each crop. This information, related to the capability to the several soil groups, was entered into an algebraic process to determine yield decreases from flooding (or increases with flood protection) for various groups of soils in the sixteen Basin plan areas. Onfarm costs were thus estimated for each crop and each flood-free yield. Data on flood-free yields and associated cost were inserted into the Economic Research Service computer program along with comparable information on irrigation and agricultural drainage.

The Economic Research Service program represents the choices, and associated costs and returns, which may be available to the Basin farmer at the projected time periods. Under the assumption that the farmer will make the economic choices which maximize his return or, in terms of the model, minimize his costs, the computer program selects the soils, yields and associated costs, and crop distribution within the Basin which reflect the "best" economic set. Since the Economic Research Service program is run under two conditions, with and without development, it is possible to estimate how a water resource program might change the character and magnitude of the resources required to meet agricultural demands. The resulting computer solution points up the relative "need" for flood control among the various Basin plan areas and the relative potential value of flood control in relation to other water-resource developments such as irrigation and drainage.

The Economic Research Service program does not include the off-farm costs of providing the water-resource developments. The change in costs and returns developed through the program thus represents a "gross" estimate of the changes in the farm economy. A more detailed study would be required to relate the water-resource investment to this onfarm economy. The water-resource investment analysis should be a major part of the later, more detailed project studies.

The analytical tools developed by the Economic Research Service for the Basin Study can be adapted to the analysis of the effect of specific water-resource investments on the agricultural economy of the region. For flood control analysis, for example, a program might be developed to include specific information about flood plain soils, flood frequency and flood damages and the prospective physical effects and associated costs attributable to proposed water resource developments. Future flood control studies in the Basin might well build on the framework procedure provided in this report.

*Used in projections of Agricultural development potential for drainage, flood protection and irrigation for UMRCBS Appendix N, Agriculture.

7.9 Fish and Wildlife, Bureau of Sport Fisheries and Wildlife*

Demand for any hunting or fishing experience is a function of participants and participation. Participants are defined as those people in a given population who hunt or fish when provided with the opportunity to do so. Participation is the number of times an individual annually hunts or fishes.

Hunting and fishing license sales are an index of participants. Licenses reflect actual use, are accurately tabulated, and are readily available. In developing methods for projecting demand, all numerically represented factors available are analyzed that could affect the sale of licenses. Two factors were found that proved to be well-correlated and significant determinants of license sales. They are: (1) human population density (population per square mile) surrounding the residence of the licensee, and (2) the amount of hunting or fishing opportunity (habitat acres per capita) available in the plan area of residence. The correlation coefficients (r) were significant at the 95 percent level of probability per square mile, and were highly significant at the 99 percent level for fishing license sales per capita and acres of fishing habitat per capita. Hunting license sales per capita were highly significant at the 99 percent levels of probability with both independent variables, population per square mile and acres of hunting habitat per capita.

Applying these factors to populations projected in this appendix, multiple regression formulas were used to project licensed fishermen and hunters. The formulas are:

Fishing

$$Y = 10.25 - 0.0156X^1 + 51.66X^2$$

Hunting

$$Y = 12.39 - 0.029X^1 + 0.148X^2$$

Where

Y = licensees as a percent of subarea population
X^1 = population per square mile
X^2 = acres of habitat per capita.

The two X variables accounted for nearly 88 percent of the variation of Y in the fishing demand equation and approximately 53 percent of the variation of Y in the hunting demand equation.

The projected licensed participants were increased by factors representing nonlicensed individuals: 50 percent for fishing and 23 percent for hunting. Estimates of latent demand were not fully considered, because of the difficulty of completely assessing this nebulous factor. Our projected demand may therefore be underestimated by a portion of the total magnitude of the latent demand factor. Origin and destination data between the Upper Mississippi River Basin and other basins, and within Upper Mississippi River Basin plan areas, were not available. Ingress-egress travel patterns between these various artificial boundaries were thus considered equal.

Participation by fishermen and hunters was based on data presented in several ORRRC reports, the *1965 National Survey of Fishing and Hunting*, and by several state studies.

Participants, as determined from the previous equations, were assessed against participation to obtain gross hunting and fishing demand for the projection years.

Net needs for the near future (1980) were determined by subtracting existing (1960) use, plus the use expected to occur on developments undertaken during the interim 1960–1980, from the projected 1980 gross demand. Net needs for 2000 and 2020 would have been determined using the same method, except going programs were not established that far into the future. Therefore, 2000 and 2020 net needs were a function of the gross demand changes in the interim years, the carryover net needs from the previous target year and, in the case of hunting needs, that portion of existing use on private acreage that would convert to "urban and built-up" areas, and be lost to the hunter in future years.

7.10 State of Illinois, Department of Business and Economic Development

Letter of February 6, 1967 by Gene H. Graves:

> The demand for water and water-related services depends on the population characteristics and the level and type of economic activity. Information on present demographic and economic conditions and estimates of future change, therefore, is fundamental to realistic water resources planning and timely development.
>
> The Illinois Department of Business and Economic Development, in cooperation with eight state agencies, has completed a statewide water resources planning study which was released during March of 1967. This study presents a preliminary, broad-scale analysis of future water needs and supply potentials by county. Future planning activities will be concerned with refining this analysis. The

*Used in translating Economic Base Study data into fish and wildlife demands for UMRCBS Appendix L, Fish and Wildlife.

economic and demographic guides formulated in the Economic Base Study prepared for the Upper Mississippi River Comprehensive Basin Study will be incorporated into this supply-demand analysis.

The analysis is designed to furnish a general appraisal of the probable nature, extent, and time of occurrence of future problems. The results will be of assistance in determining future planning priorities and state water resources policy.

The precise methodology for use of the Economic Base Study data remains to be determined. It is anticipated, however, that the projections for Basin plan areas and economic subregions will be disaggregated into projections for smaller units encompassing individual watershed areas and/or smaller county groupings. This would permit an analysis of water requirements in relation to stream segments.

In addition, the Economic Base Study projections will be valuable for a variety of other purposes. The projections may be of assistance in revising the recreation demand projections of the State recreation plan. Secondly, the Division of Highways anticipates that the projections can serve as control information in their urbanized area transportation studies. Finally, the projections will aid local and regional planning commissions, many of whom are engaged in land use planning and water and sewage planning, in relating local growth projections to the projections for economic subregions.

7.11 State of Missouri, Water Resources Board

Letter of March 3, 1967 by Clifford L. Summers:

Section 2 of the Economic Base Study, Upper Mississippi River Basin, has been reviewed by the Missouri Water Resources Board. The Board has no question regarding the reliability of the report and projections concerned with the economic subregions. We consider this work to be most reliable and it will be used in water resource and other planning by the agencies of the State of Missouri.

There is some question regarding projections for the planning subareas, particularly Planning Area No. 10 and the St. Louis SMSA which is separated between the Meramec and the Kaskaskia Planning Areas. We find that additional refinement and adjustment of projections will be necessary for use of the material by the State of Missouri.

Missouri has received economic base studies for the Missouri Basin, Spring River Basin, and the White River Basin through other comprehensive state-federal river basin studies. The methodology and results differ slightly, but cursory examination indicates the findings of the several studies to be comparable.

The Water Resources Board is engaged in breaking out the data and projections for those groups of counties contained in economic and hydrologic areas and lying outside of the State of Missouri. We have also found it necessary to break out or reassign certain counties that have been included in two or more planning areas reported from the several base studies. We are hopeful that this will permit an additive projection for the State and that it will compare favorably with information available from other sources.

We are making our own studies and projections for the Delta region in an attempt to complete the picture for the total state. This is accomplished by a direct ratio method. The other agencies of state government will be consulted and obvious adjustments made to reflect current knowledge of trends in job opportunities and population locations.

We will also prepare methodology and instructions for breaking out select groups of counties for use by our regional planning commissions. We envision through this approach the evolution of an economic base and projections for the State of Missouri that will receive acceptance and will be used by the several agencies of government and local organizations involved in planning activities. If the above can be accomplished, we envision that future planning in the State of Missouri irregardless of funding or administration will result in proposals that can be compared in making the political decisions necessary for implementation.

Any work involving breakdown or disaggregation in the State of Missouri and accomplished by the North Central Division will be useful to us. We in turn will keep your office informed of our progress and interpretation of the data now available from several sources.

7.12 State of Wisconsin, Bureau of State Planning

Letter of April 4, 1968 by Donald P. Wood:

Wisconsin has found the economic projections developed in the Upper Mississippi River Comprehensive Basin Study useful in at least two respects:

(1) They allow us a basis of comparison for the more detailed projections we developed in the course of our state planning work.

(2) They provide projections for neighboring states which we must use in planning and designing certain types of public facilities which are used, in part, by non-residents.

In addition, some of the observations made by the consultant as to factors causing economic change provide us some valuable insight to problems in Wisconsin.

Regions based on hydrologic criteria are not especially useful to us for many of our planning functions. It would be more helpful if your data could have been easily disaggregated and reassembled into various other geographic groupings.